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## *The Journal of Medicine in Industry*

With which are consolidated "The Industrial Doctor"® and "International Journal of Medicine and Surgery"


This magazine is published to promote sound thought concerning industrial medicine and the surgery of trauma. To that end it will contain articles, news items, reports, digests, and other presentations, together with editors' comments. The editorial policy is to encourage frank discussion. On this basis contributions are invited. The editors will exercise care in checking on the accuracy of data printed but in all other respects articles and opinions of which expression is allowed are the opinions of their authors—the editors reserving in all cases the right to comment on the same in the current or any subsequent issues as they may be inclined.


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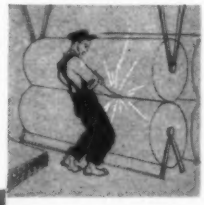

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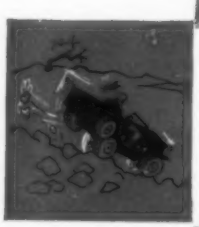

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1. Lowry, K. F.: The Management of Resistant, Non-Healing Skin Lesions: A Report of Three Cases, Postgrad. Med., to be published.
2. Niemiro, B. J.: Delayed Healing in Pilonidal Cyst Wounds, Journal Lancet, *71*:364, 1951.
3. Combes, F. C., Zuckerman, R., and Kern, A. B.: Chlorophyll—Its Use in Topical Therapy, New York State J. Med., to be published.


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gram," "Health Hazards of Cadmium," "Occupational Skin Diseases," "Health Hazards of Carbon Monoxide," "Health Hazards Associated with Metal Degreasing," "Silica and Silicosis," "The Role of the Industrial Nurse in a Present Day Industrial Health Program," "Health Hazards of Carbon Tetrachloride," "Metal Fume Fever," "The Industrial Dental Program in Pennsylvania," "Air Pollution," "Health Hazards of Solvents," "Organizing an Industrial Health Program," "The Nurse in an Industrial Dental Health Service." Copies of these may be obtained, free of cost, by writing DR. JOSEPH SHILEN, Director, Bureau of Industrial Hygiene, Department of Health, 432 South Office Building, Harrisburg, Pennsylvania.

## Slow-Down

A MEDICAL DIRECTOR found the following comment appended to the report of one of his Medical Examiners: "This wiry young executive, 32, works Sundays and all hours; meals hurried; has an excellent position; caught in the whirl of modern business; explained carefully my philosophy of living; too young to believe; needs a perforated ulcer."

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THE functions and members of the Medical Advisory Committee of the Common Cold Foundation are as follows: *Functions:* To advise the Board of Directors of the Foundation regarding industrial respiratory disease problems; propose public health programs and other general medical policies to be followed. *Members:* LOUIS L. FRIEDMAN, M.D., Consultant, Veterans Hospital, Tuscaloosa, Alabama; G. H. GEHRMANN, M.D., Medical Director, E. I. du Pont de Nemours, Inc.; BURGESS L. GORDON, M.D., President, Woman's Medical College of Pennsylvania; WARREN L. HOGUE, JR., M.D., Medical Director, Firestone Tire & Rubber Company; WILL F. LYON, M.D., Medical Director, International Harvester Company; M. H. MANSON, M.D., Medical Director, American Telephone & Telegraph Company; EDGAR MAYER, M.D., Clinical Professor of Medicine, New York University-Bellevue Medical Center; GEORGE R. MENEELY, M.D., Assistant Professor of Medicine, Vanderbilt University School of Medicine; JAY ARTHUR MYERS, M.D., Professor of Medicine and Public

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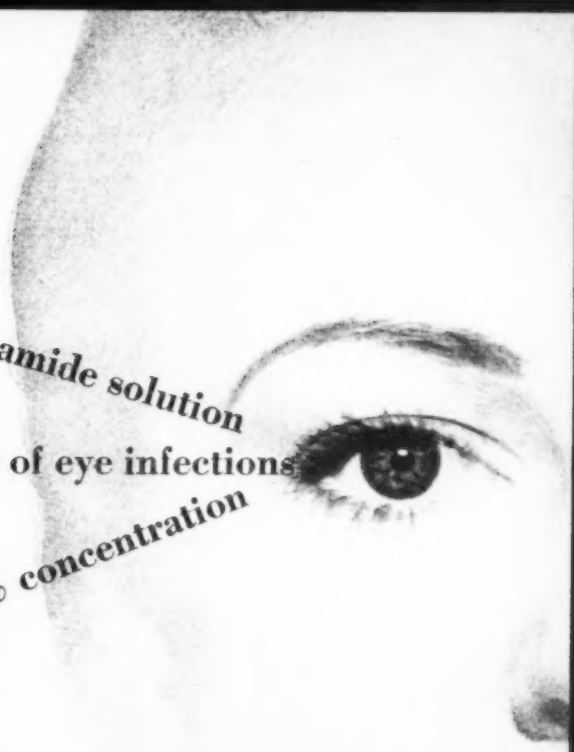

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## *64th Annual Meeting, April 1-3, 1952, at the Drake Hotel, Chicago*

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## Recent Deaths

CHARLES-FRANCIS LONG, Medical Director, Bayuk Cigars, Inc., at Philadelphia, February 28. DR. LONG was born at Wilkes-Barre, Pennsylvania, March 1, 1898. He graduated M.D. at the University of Pennsylvania School of Medicine in 1923; interned at Philadelphia General Hospital. He had been identified with industrial medicine since 1925, and had given distinguished service in the matters of health activities in small plants and the development of cooperation between industrial physicians and family physicians. He had written extensively on industrial medical subjects, particularly the problems of tobacco workers, and methods in health examinations.

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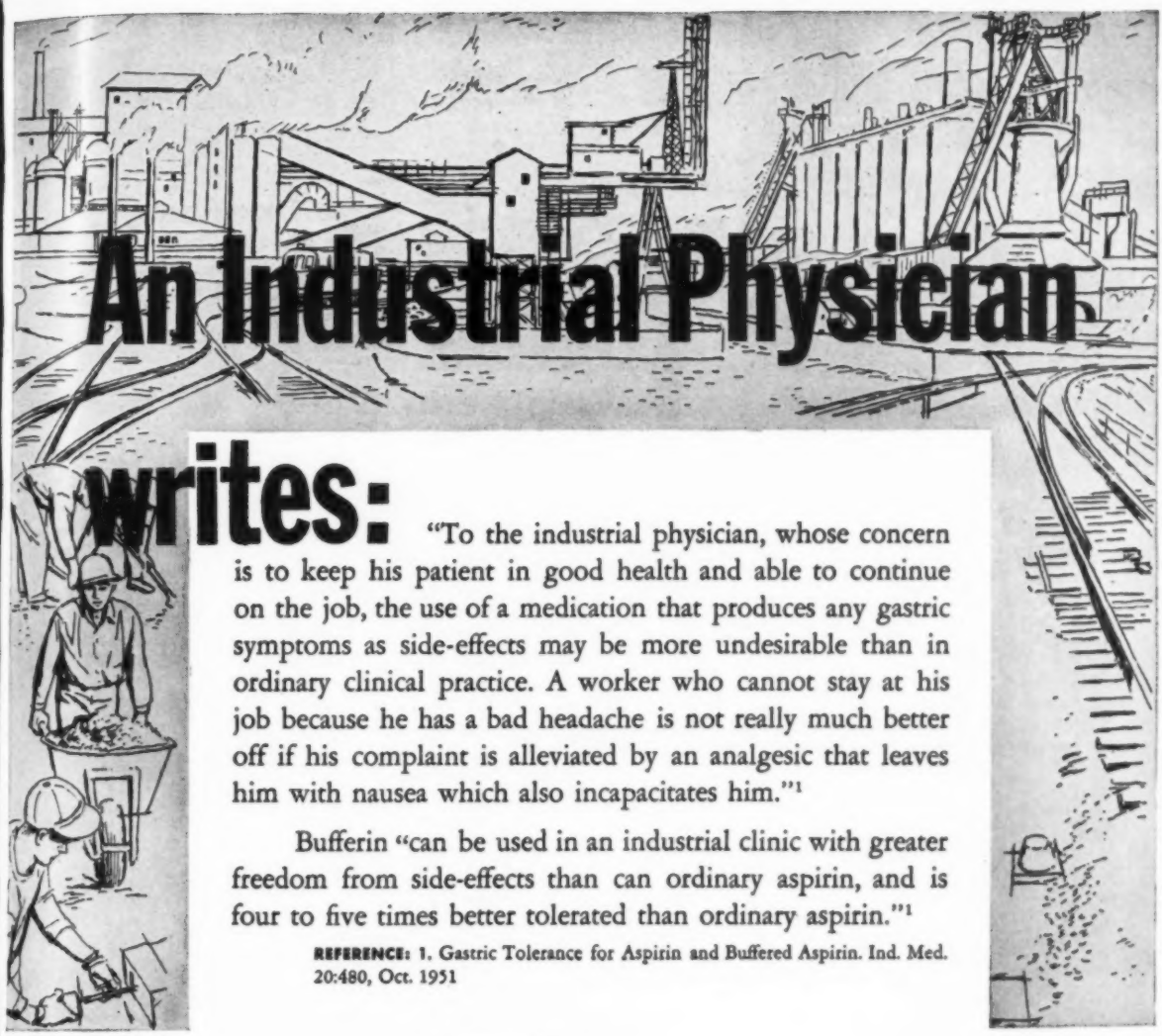
Industrial Hygiene Foundation of America, 4400 Fifth Ave., Pittsburgh 13, Pa. C. RICHARD WALMER, Managing Director.



# An Industrial Physician writes:

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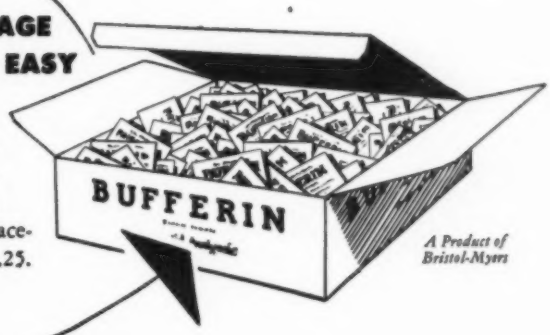


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He was Chairman of the Commission on Industrial Health and Hygiene of the Medical Society of Pennsylvania, a member of the staff at Episcopal Hospital, and acting Associate Professor of Industrial Medicine at Women's Medical College of Pennsylvania, at Philadelphia. DR. LONG was a kindly man, interested in people, forceful in behalf of what he thought was right. He was widely liked by a host of friends, and will be long remembered.

## THIS MONTH

WHAT'S NEW FOR FIFTY-TWO?" That was the title of the "Discussional" at Ann Arbor, March 26, 1952, held at the University of Michigan School of Public Health, by the School in collaboration with the Institute of Industrial Health, the School of Medicine, and the Bureau of Industrial Relations School of Business Administration. The program was informal; it was a *true discussion*. The problems were stated, and almost every one of the 80 physicians, hygienists, professors, engineers, nurses, and safety people who attended the sessions had a question, an answer, or a suggestion. It is our hope that we may later publish a summary of the three sessions. Meanwhile there evolved from the discussions several expressions so pungently aphoristic that they would do credit to an Osler. Here are four of them. *"Industry doesn't hire disabilities; it hires skills"*—MAX BURNELL, Medical Director, General Motors. *"Industrial medicine is taught in the school, but it is learned in the plant"*—OTTO TOD MALLERY, JR., Director of the Institute of Industrial Health, Associate Professor of Internal Medicine, and Chief, University Hospital Clinical Laboratories, University of Michigan. *"The industrial nurse should never be a diagnostician; she should always be a suspectician"*—ELLA E. MCNEIL, Professor of Public Health Nursing in the School of Education of the University of Michigan. *"A good work-environment is a good-work environment"*—WARREN A. COOK, Director, Division of Industrial Hygiene and Engineering Research, Zurich-American Insurance Companies .... ONCE when DR. C. O. SAPPINGTON, of beloved memory, was our Editor, he was shown a mis-spelled word in *Industrial Medicine*. Instead of chiding the proofreader, he told him about the printer, temporarily out of work, who got a job as a waiter. One noon a customer complained: "Waiter, there's a needle in my soup." To which the ex-printer replied: "It's a typographical error; should'a been a noodle." An old story, retold here because —but don't look now—there were three "should'a been noodles" in our last issue .... THIS is a Want Ad: We need some back numbers of certain issues of *Industrial Medicine* and will pay the current copy price plus postage. They may be sent to this Journal, 605 North Michigan Ave., Chicago 11. The ones we need are: December, 1932; October, 1933; February, 1934; December, 1935; September, 1949 ... THE first ARNOLD D. TUTTLE MEMORIAL AWARD for research in aviation medicine has been presented to DR. EDWARD H. LAMBERT, of the Mayo Foundation. Presentation was made by DR. GEORGE KIDERA, United's Medical Director, at the annual dinner of the AERO MEDICAL ASSOCIATION, in Washington. He cited DR. LAMBERT'S research on problems of acceleration and in perfecting anti-blackout suits for military personnel. The award was established by United Airlines for annual presentation. It commemorates the late COL. A. D. TUTTLE, United's Medical Director from 1937 to 1951.

Some of the Participants in the Discussional on "What's New for Fifty-Two" at the University of Michigan School of Public Health, March 26, 1952.



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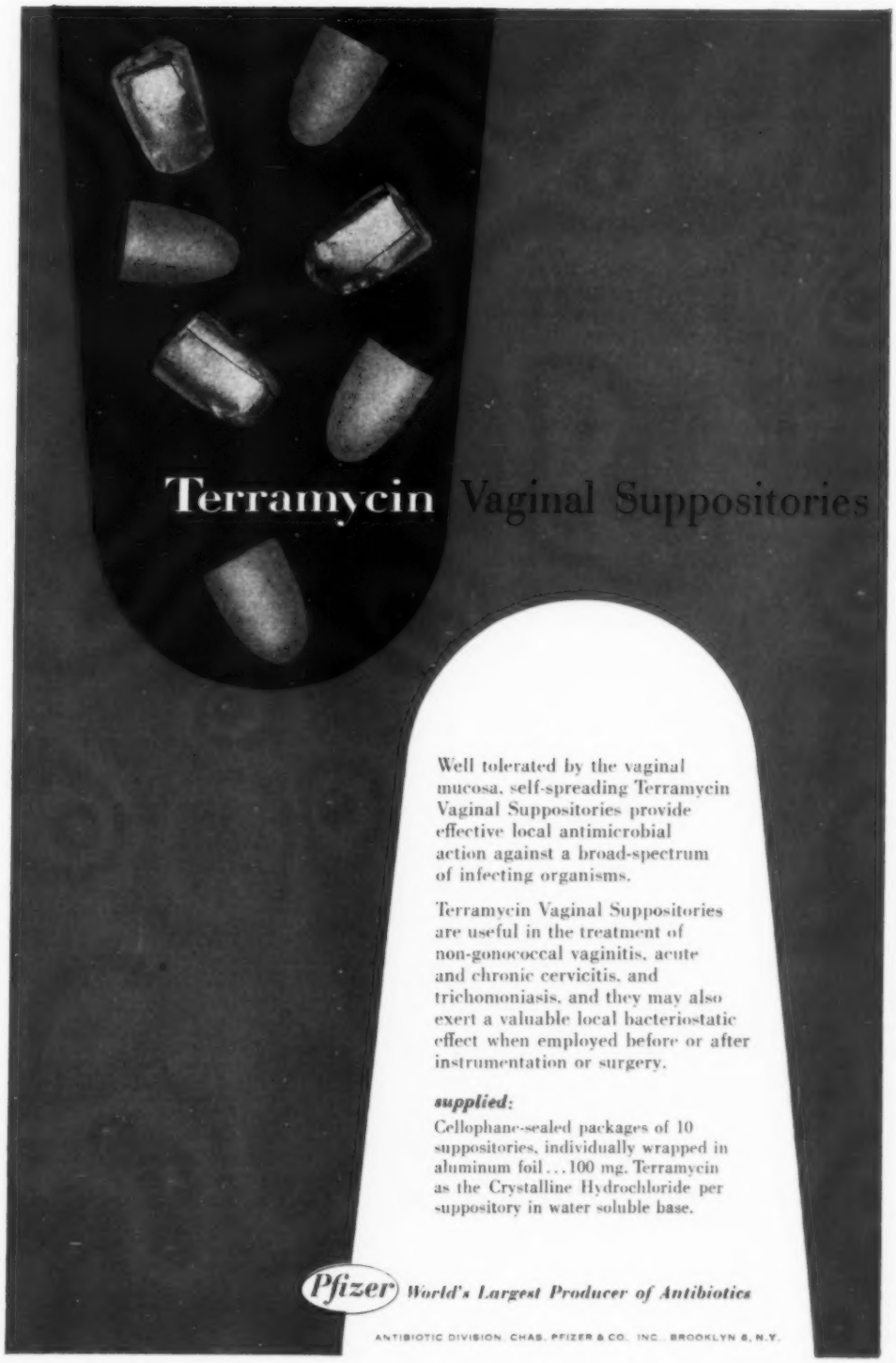
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Industrial Medical and Related Chronology selected and arranged by ROBERT T. LEGGE, M.D., F.A.C.S., Berkeley, California

....All experience is an arch wherethrough
Gleams the untraveled world....
How dull it is to pause and make an end,
To rust unburnished, not to shine in use,
As though to breathe were life....
—Tennyson

♈ = Aries — March 21-April 20 ‖ ♉ = Taurus — April 20-May 20

**1952 APRIL**

THE LADY APRIL, saffron jeweled, came in—her retinue small songsters, lilting the songs they bring, her pathway lined with the lifted heads of little growing things, while "earth, her waters, and the depths of air" are fragrant with new Spring. But politics, *nee* Taurus, lurks in the wings—and though his fields are hungry for the plow and the sowing, man must turn his mind to the winnowing of truth from the chaffs of promise and the "alarms and excursions" of the powers that swarm upon him. Let him look from the broken blue eggs beneath his apple tree to the nest of living birds above, and ponder the verities of things greater than himself....

☽ 1st Quar. ○ Full Moon ☾ 4th Quar. ● New Moon

**1** ♈ Tu
1578—William Harvey born at Folkstone, Kent, England. Discovered the circulation of the blood. First published his book at Frankfort in 1628.
1952—All Fools' Day....
*"Superfluity of lecturing causes ischial bursitis"—Osler*

**2** ☽ W
1948—Theodore Lyle Hazlett, Medical Director, Westinghouse Electric, Professor of Industrial Hygiene, University of Pittsburgh, given the Knudsen Award, at AAIPS Convention, Boston.
1919—League of Red Cross Societies founded at Cannes.

**3** ♈ Th
1749—Dr. David Ramsay born at Drumore Township, Pennsylvania. Surgeon, Revolutionary War. Author "Sketch of the Soil," "Climate, Weather and Diseases of South Carolina," "History of the Revolution of South Carolina."

**4** ♈ Fr
1727—Isaac Newton, intellectual giant of his day, died. Made three great discoveries: mathematical method of fluxion (physical problems involving force and motion); law of composition of light (the science of optics); law of universal gravity.

**5** ♈ Sa
1827—Joseph Lister born at Upton in Sussex. Regius Professor of Surgery, University of Glasgow. Applied Pasteur's discoveries to surgery, using antiseptics.
*"A woman's advice is not worth much, but he who doesn't heed it is a fool"—Pedro Calderon*

**6** ♈ S
1907—Chevalier Jackson, a Philadelphia laryngologist, introduced gastroscopy.
*"You must treat a work of art like a great man; stand before it and wait patiently till it deigns to speak"—Schopenhauer*

**7** ♈ M
1940—Wilmer Cave Wright, Professor of Greek, Bryn Mawr College, translated Ramazzini's "De Morbis Artificum," 1713 edition, into English.
*"What do you suppose will satisfy the soul except to walk free and own no superior?"—Whitman*

**8** ♈ Tu
1869—Harvey W. Cushing born, to become the pioneer and foremost neurosurgeon in the world. His seventieth birthday was celebrated at New Haven by the Harvey Cushing Society.
*"Men are as the time is"—Shakespeare*

**9** ♈ W
1936—Howard M. Clute (1890-1946), Boston surgeon, developed a clamp for closure of the duodenal stump in gastric sections.
*"Half of us are blind, few of us feel, and we are all deaf"—Osler*

**10** ○ Th
1753—Samuel Christian Hahnemann born at Neissen, Saxony; a German physician; founder of homeopathy.
*"Keeping accounts is of no use when a man is spending his own money. You won't eat less beef today because you wrote down what it cost yesterday"—Samuel Johnson*

**11** ♈ Fr
1777—Dr. William Shippen, Jr., appointed Dr. Morgan's successor as Director General and Physician in Chief of Colonial Army Hospital.
*"If a dog falls in love with you at first sight it will do to trust him—not so with a man"—Josh Billings*

**12** ♈ Sa
1838—John Shaw Billings born in Indiana. A U.S. Army surgeon in the Civil War; later attached to Surgeon General's office; prince of bibliographers; author "Medical and Surgical History of the Civil War" and the "Medical Index."

**13** ♈ S
1912—Clara Barton, founder of the American Red Cross, died.
1813—Dr. Benjamin Rush, Professor of Medicine, University of Pennsylvania, died. A signer of the Declaration of Independence.

**14** ♈ M
1873—Medical Department, University of California, established, taking over Toland's Medical College, opened in 1864.
1942—Clarence D. Selby, Medical Consultant, General Motors Corporation, given Knudsen Award at AAIPS Convention at Cincinnati.

**15** ♈ Tu
1720—Felice Fontana, physiologist of Trentino born at Ponsavole, Austria; pioneer in the investigation of serpent venom.
1865—President Abraham Lincoln died at Washington.
*"After all, faith is the great lever of life"—Osler*

**16** ♈ W
1920—John Brownlee (1868-1927), English physician, discovered signs of edema of the lids. Public health administrator in epidemic of measles.
*"The greater the ignorance, the greater the dogmatism"—Osler*

**17** ☾ Th
1949—Robert A. Kehoe, Director, Kettering Laboratories of Applied Physiology, University of Cincinnati, given the Knudsen Award at Detroit.
*"If a man can describe a pretty girl without using his hands, he is educated"—The Kalends*

**18** ♈ Fr
1887—Frederich Loeffler (1852-1910), of Frankfort on the Oder, announced the discovery of the diphtheria bacillus.
*"In taking histories follow each line of thought; ask no leading questions; never suggest"—Osler*
*"Trust thyself: every heart vibrates to that iron string"*

**19** ♈ Sa
1836—Charles R. Darwin, the distinguished naturalist, died. Buried at Westminster Abbey, London.
*"It is astonishing with how little reading a doctor can practice medicine, but it is not astonishing how badly he may do it"—Osler*

**20** ♉ S
1745—Phillipe Pinel born at St. Paul Cap de Joux, France. Liberator of the insane at Bicetre Hospital, Paris; removed the chains; considered that an insane person is a sick patient and not a criminal; a new era in asylum administration.

**21** ♉ M
1854—Adolph Lorenz born in Silesia. Chief of Orthopedics, Imperial Royal General Hospital, Vienna; famous for method of reduction of congenital dislocation of the hip joint.
*"The wild pear is now in bloom."*

**22** ♉ Tu
1899—Liverpool School of Tropical Medicine opened by Lord Lister, discoverer of antiseptic and aseptic surgery.
*"No man can produce great things who is not thoroughly sincere in dealing with himself"—Lowell*
*"A rare and precious gift is the art of detachment"—Osler*

**23** ♉ W
1887—Sir Victor A. H. Horsley, English neurologist and surgeon, described operation on brain and cranial cavities, illustrating details, safety of methods employed.
*"All things that are, are with more spirit chased than enjoyed"—Shakespeare*

**24** ● Th
1792—The guillotine for the execution of murderers invented by Dr. Joseph Ignase Guillotin, of Paris.
1838—William Thompson, M.D., F.E.C.P., Edinburgh, read his paper on "Black Expectoration and the Disposition of Black Matter in the Lungs."

**25** ♉ Fr
1810—Jonathan M. Foltz born at Lancaster, Pennsylvania; with Farragut on the Hartford during the Civil War. Became Surgeon General of the U.S. Navy.
*"In the field of observation, chance favors the prepared mind"—Pasteur*

**26** ♉ Sa
1951—Robert T. Legge, Professor Emeritus, University of California, given the Knudsen Award at IMA Convention at Atlantic City.
*"The only argument available with an east wind is to put on your overcoat"—Lowell*

**27** ♉ S
1950—Edward Charles Holmblad, Managing Director, Industrial Medical Association, given the Knudsen Award at AAIPS Convention in Chicago.
*"Our intellectual and active powers increase with our affection"—Emerson*

**28** ♉ M
1842—Charles Bell, famous Scotch anatomist and surgeon, died at Hallow Park near Worcester. Was Professor of Surgery at Middlesex Hospital, London. The long nerve of Bell and Bell's palsy named after him.
*"Any hill is too high for a poor climber."*

**29** ♉ Tu
1897—J. J. Thompson, Professor of Physics, Cambridge University, announced the discovery of the electron under the name of corpuscles of electricity. Nobel Prize winner.
*"An epigram often flashes light into regions where reason shines but dimly"—Martial*

**30** ♉ W
1879—Louis Pasteur delivered the celebrated lecture on the "Germ Theory" in which he stated that the hypothesis of spontaneous generation is a chimera.
*"Give every man thine ear, but few thy voice"—Shakespeare*

*"Inevitably the doctor's work in the future will be more and more educational, and less and less curative. More and more will he deal with the physiology and psychology of his patient, less and less with his pathology. He will spend his time keeping the fit fit, rather than trying to make the unfit fit."—Lord Harder.*

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# Pole Top and Other Manual Resuscitation Methods
## — A Comparison Study —

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EVALUATION of the efficiency of various manual methods of artificial respiration has usually been left to "physiologic intuition" and the uncontrolled results available from field application. However, intensive and coordinated studies have recently established the superiority of "push-pull" manual resuscitation methods over Schafer prone pressure in controlled experimental studies.[1,2,3] This has been made possible, in part, by the development of a satisfactory technique for producing total apnea in normal adults, during which the ventilatory efficiency of the various methods can be studied comparatively.[4] Previous tests have not included data on the pole top method of resuscitation. This report details a study of the pole top and manual resuscitation techniques using normal adult males curarized-anesthetized to total apnea.

### Previous Studies on "Push-Pull" Methods

STUDIES on warm, non-rigid corpses, immediately after death and before the onset of postmortem changes,[5] normal human volunteers with drug-induced apnea,[6] and hospital patients who have become apneic as a result of intracranial pathology[7,8] have indicated unequivocally that "push-pull" techniques are two to three times as effective as Schafer prone pressure as regards pulmonary ventilation. The former produce active inspiration and active expiration; the Schafer method is only actively expiratory.

The circulatory effects resulting from uninterrupted 15-minute performance periods with each of the various methods have been observed on normal adult male volunteers rendered totally apneic with barbiturate-curare mixtures.[9] With all of the push-pull methods, the mean arterial oxygen saturation was maintained at near-normal levels; with the Schafer method, however, the mean arterial oxygen saturation reached an abnormally low level. In three of nine cases it was necessary to discontinue the Schafer method because of alarming cyanosis of the subjects. In each of those cases in which prone pressure was unable to maintain the apneic volunteer for the 15-minute experimental period, the push-pull method immediately preceding it and the push-pull method immediately following it were always able to oxygenate the subjects adequately.

These data, together with pneumotachographic determinations of ideal rate,[10] and controlled studies of the pedagogical[11,12] and fatigue factors[13,14] involved in application of the methods, have led to the recommendation by the National Research Council that these newer methods should replace the Schafer prone pressure method. Such recommendations have been accepted by the American National Red Cross, Department of Defense, U.S. Public Health Service, Federal Civil Defense Agency, Council on Physical Medicine of the American Medical Association, and numerous other national agencies.

### Methods

FIVE normal healthy adult males were used in this study. These subjects were rendered totally apneic by means of intravenous pentothal sodium and d-tubocurarine chloride. An endotracheal tube was inserted into the trachea to maintain a clear airway at all times. This was secured by an inflatable cuff and connected to a carefully-balanced recording spirometer, by which the amount of pulmonary ventilation accomplished by the maneuvers was measured. A complete series of determinations, including the pole top method, was made on each subject. Following each method, mixtures of cyclopropane and oxygen were administered to the subjects in order to maintain their apneic state.

*Pole Top Method:* In 1931 Oesterreich[15,16] developed the pole top method of resuscitating linemen who were shocked on the poles. Since that time a remarkable number of successful applications have been reported. One of the

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Fig. 1.
Pole top method being performed in these tests on totally apneic anesthetized-curarized subject. In this view, the chest compression modification is being applied.

method's prime features is the speed with which it can be applied, thereby eliminating the tragic delay which results from first lowering the victim to the ground.

Kouwenhoven, Hooker and Langworthy[17] studied the method in volunteers who passively suspended their respiration. They found that, in this type of subject, the pole top technique gave greater tidal exchange than the Schafer method.

In the performance of pole top resuscitation, the rescuer immediately ascends to the victim. He secures his safety strap around the pole and places the victim astride it between himself and the pole. He encircles with his arms the waist of the victim, placing both hands on the abdomen, thumbs below the lower ribs and fingers touching. With his arms and hands, he compresses the victim's abdomen in an upward motion. At the finish of the stroke, the hands are cupped with the fingers depressing the abdomen under the rib margin. The pressure is quickly released and reapplied at a frequency of 12 to 15 times per minute.

*Schafer Method (prone pressure):* The standard Schafer method[18] is performed with the subject prone, the elbows flexed, and the head resting on the back of one hand. The operator straddles one or both legs of the victim and rhythmically exerts pressure on the flanks over the floating ribs with the fingers together. Pressure is exerted 12 times per minute with a relaxation phase following each maneuver.

The older *Howard method* (chest squeeze)[16] was also evaluated in these studies. With this technique the subject is in the supine position and the pressure is exerted in an antero-posterior and lateral direction upon the lower ribs.

*Arm-Lift Back-Pressure Method (back-pressure arm-lift):* This method, modified from the Danish Holger Nielsen,[19] also utilizes the prone position. However, in this case the arms are flexed, the hands placed upon each other, and the head, turned to one side, placed on the backs of the hands. The operator kneels, facing the victim and at his head. He may kneel on either knee or on both if this is more comfortable. The operator places his hands under the arms of

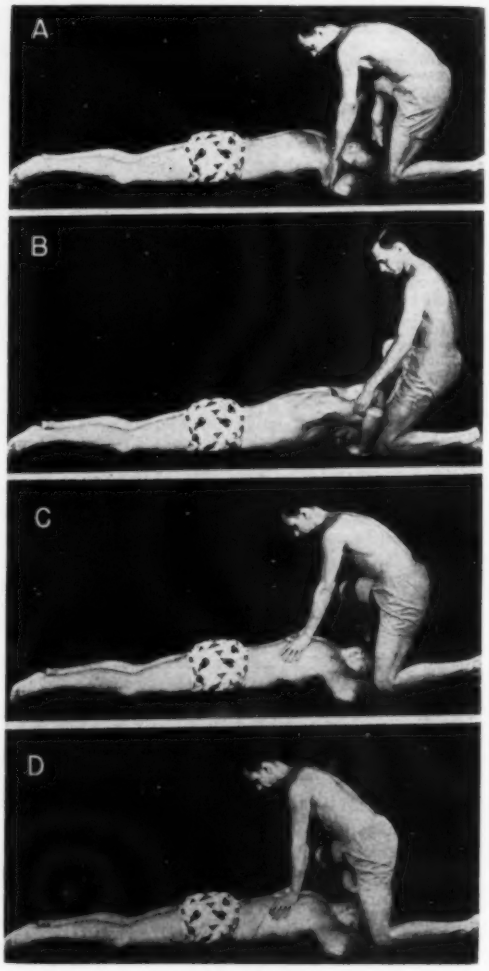


Fig. 2.
Arm-lift back-pressure method:
(A) Starting position for arm-lift.
(B) Arm-lift, with operator rocking backward and keeping his arms straight.
(C) Starting position for back-pressure.
(D) Back-pressure with operator rocking forward and keeping arms straight.

the victim just above the elbows. He then rocks backward, keeping his elbows straight and drawing the victim's arms upward and toward himself. This lift is continued until firm resistance is met. The arms are then replaced on the ground and the operator moves his hands to the patient's back. He places his hands over the mid-back with the fingers spread downward and outward, the thumbs touching at the spine and the heels of the palms at the level of an imaginary line drawn between the two axillae. He then rocks forward, keeping his arms straight, and allows the weight of the upper part of his body to exert steady, gradual pressure almost vertically downward upon his hands until he meets firm resistance. The operator then rocks backward and repeats the cycle. Each phase of the cycle occupies an equal amount of time, and 10 to 12 complete cycles are performed per minute.

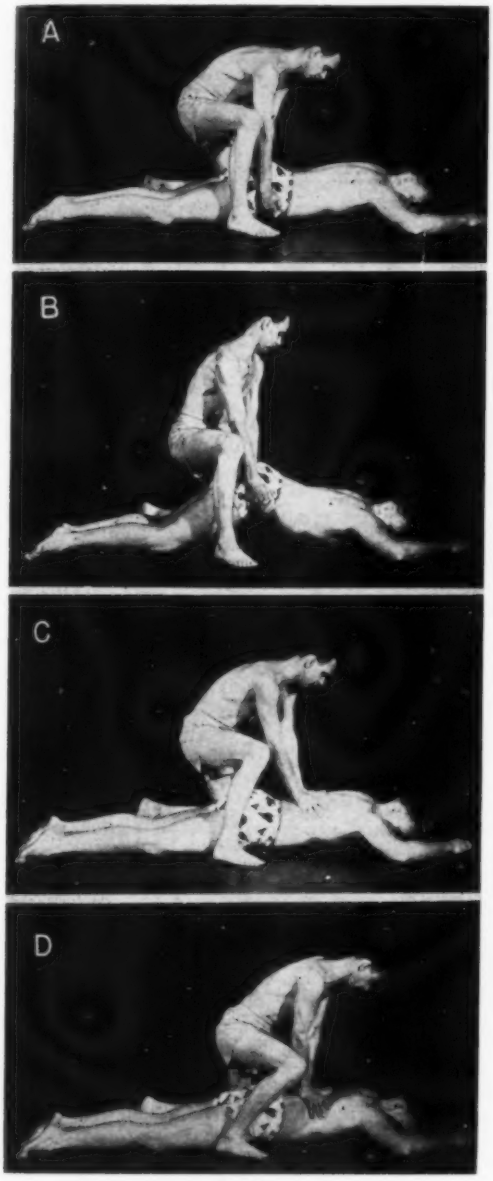


Fig. 3.
Hip-lift back-pressure method:
(A) Starting position for hip-lift.
(B) Hip-lift, with operator raising hips 4 to 6 inches and keeping elbows straight.
(C) Starting position for back pressure.
(D) Back-pressure with operator rocking forward keeping elbows straight.

*Hip-Lift Back-Pressure Method:* For this method the operator kneels on either the right or the left knee at the level of the patient's hips. The other foot straddles the victim and is placed on the ground near his opposite hip. Thus, the heel is directly opposite the kneeling knee. The operator places his hands under the victim's hips and lifts them upward approximately four to six inches. This allows the abdomen to sag downward, the diaphragm descends and air is sucked into the lungs. The operator's arms are kept straight during the lift so that the work is done by the shoulders and back rather than by the arms themselves. The hips are then replaced on the ground and the hands are moved to the mid-back, over the lower tips of the shoulder blades. The operator then rocks forward and allows the weight of the upper part of his body to exert gradual pressure almost vertically downward until he meets firm resistance. The fingers are kept spread and the thumbs almost touch at the spine. The elbows are also kept straight during the back-pressure phase. Ten to 12 complete cycles per minute are completed.

An adjunct, such as a belt, rope, towel, etc., may be used under the hips to assist in lifting. The hip-roll back-pressure method is a modification that was suggested as a simplification of the hip-lift back-pressure. It makes the method easier to do, but has been found more difficult to teach and perform correctly. In this modification, the operator kneels in the same position as for the hip-lift back-pressure. However, instead of lifting both hips, he rolls the victim's hip up onto his knee or thigh so that, in effect, both hips are elevated from the ground without lifting. He sways his body in the same direction as he rolls the victim.

*Silvester Method (arm-lift chest pressure):* This old method is one of the few supine methods that has withstood the test of time. The operator kneels at the head of the supine victim and grasps the arms just above the wrists. First the arms are raised vertically upward and then drawn back down to the ground above the victim's head. This results in active inspiration. They are then placed on his chest and the operator rocks forward and exerts gradual pressure almost vertically downward to cause active expiration. This cycle is repeated rhythmically 12 times per minute.

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TABLE I.
PULMONARY VENTILATION RESULTING WITH MANUAL METHODS OF ARTIFICIAL RESPIRATION ON NORMAL ADULT MALES CURARIZED-ANESTHETIZED TO APNEA*

| METHOD | VARIATION | | Average (cc./resp.) |
|---|---|---|---|
| Resting | Tidal air | | 588 |
| | Vital capacity | | 4349 |
| Pole top Method | Operator compressing victim's chest | | 851 |
| | Standard method with compression of abdomen | Operator using gloves | 725 |
| | | Operator without gloves | 695 |
| | | Victim's belt released | 680 |
| Katsu Method (Sitting squeeze) | Using chest compression | | 905 |
| | Using abdominal compression | Victim's arm as lever | 571 |
| | | Operaotr's hands used for pressure | 635 |
| Howard | (Supine)—pressure over lower ribs | | 469 |
| Schafer | (Prone)—back-pressure | | 486 |
| Hip Roll (Emerson) | Hips rolled onto operator's knee or thigh | | 398 |
| Hip Lift (Emerson) | Both hips lifted 4 to 6 inches | | 650 |
| Hip-Roll Back-Pressure | Standard | | 922 |
| Hip-Lift Back-Pressure | Standard | | 1189 |
| Arm-Lift Back-Pressure | Standard | | 1115 |
| Silvester (Arm-Lift Chest-Pressure) | Victim's arms raised to vertical | | 691 |
| | Victim's arms brought above head to horizontal | | 1118 |

*All methods compared on each of five subjects using a rate of 12 times per minute. Averages represent mean of all five cases.

*Katsu Method:* This method is of uncertain origin, but the name Katsu is from the Japanese. It has also been described for use by the military in special circumstances.[20] It is essentially similar to the pole top method except that it is applied by an operator sitting behind the victim on the ground. The operator sits on the ground with the victim between his legs and resting against his body. He encircles the body, with his arms beneath the victim's, and places his hands against the abdomen below the waist. The method then consists of rhythmic compression of the abdomen 12 times per minute. In this work several modifications of this method were applied: (a) the operator's arms compressing the chest; (b) grasping the victim's wrist and elbow and using his arms as a lever against the lower abdomen to move the viscera upward against the diaphragm; and (c) using the operator's hands against the victim's lower abdomen to squeeze the organs upward against the diaphragm.

*Eve Rocking Method:* Strictly speaking, the Eve rocking method[21] for activation of the inert diaphragm is not a manual method since it requires a rocking device, either improvised or provided. A manual method must always be used first and until such equipment is made available. The patient is first rocked 45° in a head-down position, causing active expiration, and then 45° into a feet-down position, resulting in active inspiration. The method was not included in this study, but did receive consideration in previous tests by this group.

## Results

TABLE I shows the mean values for the pulmonary ventilation obtained on these five subjects. As in previous tests, it can be seen here that all of the push-pull methods (hip-roll back-pressure, hip-lift back-pressure, arm-lift back-pressure and Silvester arm-lift chest-pressure) are between two and three times as effective as the push only (Schafer, Howard) or pull only (hip-lift, hip-roll) methods. This relationship holds for the individual comparative results as well as for the mean values. There is no practical or statistically significant difference between the amount of ventilation accomplished with the arm-lift back-pressure, hip-lift back-pressure, and arm-lift chest-pressure (Silvester) methods; the hip-roll back-pressure gives lower amounts of ventilation. Significantly, the Silvester method gives only 60% as much ventilation when the arms are raised only to the vertical as when they are drawn back to the ground above the victim's head.

These data are comparable to those previously obtained in other studies on normal adults curarized-anesthetized to total apnea (Table II). The values previously obtained in the studies on warm, non-rigid corpses are included here for comparison. It can be seen that, although the absolute values are lower, the comparative values between the push-pull methods and the push only or pull only methods are about the same.

During standard performance of the pole top method values were obtained which were intermediary between the push or pull only methods and the push-pull methods. It was observed that compression of the victim's chest by the operator, rather than compression of his abdomen, resulted in somewhat more ventilation. Slightly less ventilation than with the pole top method and only about half as much as with the push-pull method was obtained with use of the Katsu

TABLE II.
COMPARISON OF RESULTS OBTAINED USING MANUAL METHODS OF ARTIFICIAL RESPIRATION IN STUDIES ON WARM, NON-RIGID CORPSES AND ON NORMAL MALE ADULTS CURARZED-ANESTHETIZED TO TOTAL APNEA

| Method* | Mean Tidal Volume (cc./respiration) | |
|---|---|---|
| | Warm, Non-Rigid Corpses | Normal Adults Curarized-Anesthetized to Total Apnea |
| Schafer back-pressure | 185 | 485 |
| Hip roll | 192[1] | 422[2] |
| Hip lift | 270 | 643[3] |
| Hip-roll back-pressure | 406[1] | 967 |
| Hip-lift back-pressure | 530 | 1140 |
| Arm-lift back-pressure | 580 | 1056 |
| Arm-lift chest-pressure (Silvester) | 520 | 1069[3] |
| Pole-top method | — | 725[3] |
| Eve rocking method | 225 | 751[4] |

*All methods performed on each of 26 cases in each series except where otherwise indicated. All methods at rate of 12 times per minute.
(1) 8 cases only (3) 5 cases only
(2) 15 cases only (4) 10 cases only

method. Here chest compression significantly increased the amount of tidal ventilation.

## Comment

THE doubled and tripled artificial ventilation possible with the push-pull methods is here again portrayed very pointedly (Fig. 4). Since the victim requiring artificial respiration is in crucial need of additional oxygen, this increased tidal volume is most desirable. For general use, the arm-lift back-pressure method is probably best since it: (1) uses the beneficial prone position; (2) is easy to teach and perform accurately; (3) has been shown not to be detrimental to circulation; (4) can be performed by small and large individuals alike on a wide range of body sizes, including children; and (5) has been shown by 20 years' experience in the Scandanavian countries to be effective in actual practice. The hip-lift back-pressure is equally effective and beneficial. However, fatigue with hip-lifting restricts its use to short periods of time and physically stalwart individuals. Trained personnel should know this method in addition to the arm-lift back-pressure, so that they will have it available as a ready alternative when injuries or other restrictions limit the usefulness of the preferred arm-lift back-pressure.

The hip-roll back-pressure method gives less ventilation and requires more specific training to assure adequacy of roll. Although slightly less fatiguing than the hip-lift back-pressure, these factors limit its usefulness for general indoctrination. The Silvester arm-lift chest-pressure method results in excellent respiratory and circulatory effects. However, use of the supine position is a limiting factor. Earlier tests on corpses[5] have shown that in at least 50% of cases in which the supine position is used the tongue and jaw obstruct the airway unless a mechanical airway is used or a second rescuer is available to prevent this occurrence. For trained personnel, who are cognizant of this danger and can prevent its occurrence, this method is excellent for victims with injuries or burns of the abdomen and chest, pregnant women, patients in bed, and victims trapped in the supine position. The alternative for such cases is mouth-to-mouth breathing, which is con-

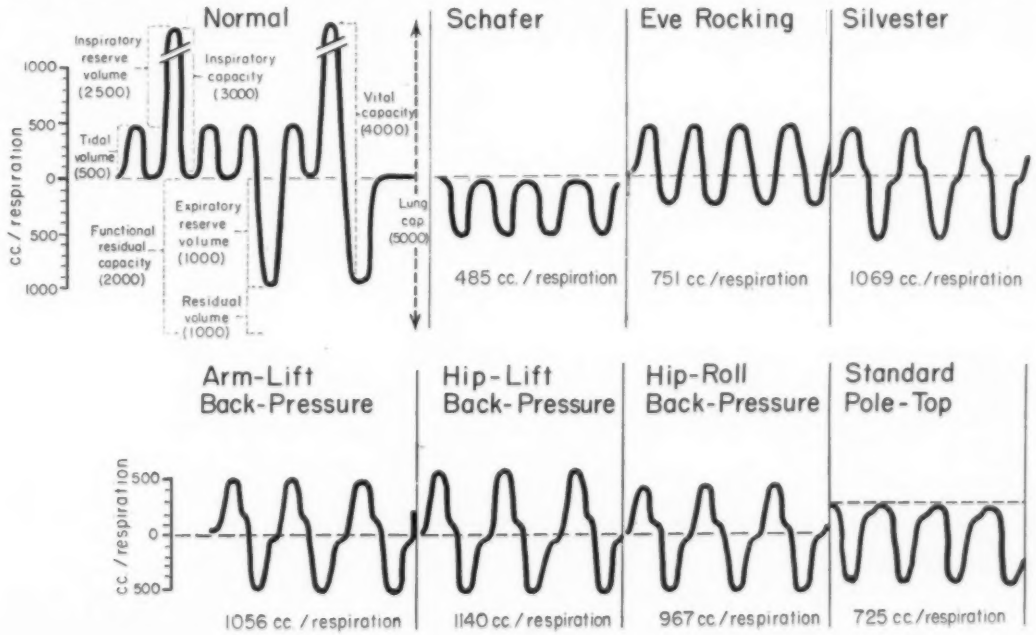


**Fig. 4.**
**Spirometric tracings for normal ventilatory components and various methods of resuscitation.**

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sidered effective, but is usually not well-known.

The practical effectiveness of the pole top method can be appreciated from the good tidal volumes obtained in this series. The fact that removal of the victim's belt or operator's gloves does not augment the ventilation adds further weight to the importance of instituting the method at once, wasting as little time as possible. Time, here, is truly of the essence; seconds count. Although the pole top method gives ventilatory values which are adequate, this does not indicate that the victim should be kept on the pole for a long time while the method is being administered. The dependent vertical position of the victim will impede venous return and prove deleterious to an already embarrassed circulatory system. Therefore, the victim should have this method started at once; as soon as is practical he should be lowered to the ground, while the method is continued, and one of the push-pull methods should be started as soon as he can be placed in the prone position. Although compression of the victim's chest, rather than his abdomen, gave somewhat greater ventilatory volumes, it cannot be assumed that this modification is superior to the standard technique. Zealous use of the chest compression modification might lead to fractured ribs. Also, the massaging effect of the abdominal compression would tend to enhance the return of blood to the heart.

The pole top method is actually a push method, since it actively forces air out by elevation of the diaphragm; inspiration occurs passively as the diaphragm returns to its resting position. However, when the body is vertical, the resting position of the diaphragm is displaced downward, so that after each active expiration, the diaphragm returns to a resting level, resulting in the lungs being partially inflated. This is shown in Fig. 4 by the upward displacement of the base line (increased resting lung-volume level).

During the use of the Katsu method the ventilatory volumes obtained were somewhat greater than with the Schafer method, but significantly lower than those achieved with the push-pull methods. This method has the additional disadvantage of circulatory embarrassment with the vertical position as well as possible difficulty in maintaining an unobstructed airway. The chest compression modification of this method gives greater ventilation but again poses the increased hazard of fractured ribs.

Accordingly, one of the prone push-pull methods should always be used as soon as the victim is brought to the ground.

## Summary

COMPARATIVE tests of pole top and manual resuscitation techniques, as carried out on normal adults curarized-anesthetized to total apnea, confirm the finding that push-pull methods are two to three times as efficient, as regards pulmonary ventilation, as either the push or the pull only methods. For general purposes the arm-lift back-pressure, (back-pressure arm-lift) modified from the Danish Nielsen method, should be used, since it is easy to teach, can be performed by most operators for prolonged periods of time, and gives excellent pulmonary ventilation without circulatory embarrassment. Trained personnel should also be acquainted with the hip-lift back-pressure and Silvester arm-lift chest-pressure methods to be used as ready alternatives in special circumstances.

The pole top method of resuscitation gives adequate ventilation, and should be instituted immediately in cases where linemen are shocked on the poles. However, since the vertical position predisposes to peripheral stasis and circulatory embarrassment, as well as impeding the drainage of fluids which may collect in the oropharynx, the victim should be lowered to the ground as soon as practical. The pole top method should be continued during the descent, and one of the more efficient push-pull methods begun as soon as he can be placed in the prone position.

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# Sequelae in a Case of Electric Shock

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THERE is a popular belief that electric shock either kills the victim or passes off leaving nothing but a mild hysteria in its wake. There are no recorded chemical studies in cases which apparently made a complete recovery in spite of considerable emotional disturbance. For this reason, the following case is presented in some detail.

W.S. appeared much older than his age of 33. His hair was entirely gray, his sclerae muddy, and his skin and mucous membranes pale and flabby. He was restless and sweating profusely, and there was a marked tremor of the head, tongue and hands. His muscles were well-developed and his reflexes normal.

He stated that he was born in New Jersey in 1918, and had worked as a ship's carpenter since the age of 21. He had always been in robust health, as was borne out by repeated physical examinations, and he had a head of thick black hair. On November 4, 1949, he took a skill-saw instead of the usual chisel to remove the worn bushing from a propeller shaft. He pulled the trigger and remembers nothing further until he came out of coma in a hospital eight hours later. Apparently his helper had failed to ground the machine, and he received a severe shock, so that he had to be pulled from the tube by fellow workmen and sent off in an ambulance. He remained in the hospital two days, and then rested at home for a month. He was diagnosed as neurasthenic. At the time I saw him on April 6, he complained of feeling weak and tired all of the time, with frequent dizzy spells. His pulse was 76, temperature 98.3°, respirations 24, and blood pressure 120/80. Urinalysis: protein 2 plus; alkaline; amber; clear; sp. g. 1.025; sugar negative. Microscopic: cylindroids; **hyaline and epithelial casts. Blood** count: hemoglobin 13 gm.; red blood cells 3 million: white blood cells 4.4 thousand; neutrophils 52%; lymphocytes 41%; monocytes 2%; eosinophils 3%; basophils 2%; no abnormal cells seen; platelets 80,000. Chemical findings: blood sugar 94 mg. %; serum non-protein nitrogen 82 mg. %; serum uric acid 8.8 mg. %; serum cholesterol 308 mg. %; serum free cholesterol 95 mg. %; serum comb. cholesteral 213 mg. %; serum total inorganic phosphorus 3.7 mg. %; serum bilirubin 1.8 mg. %; serum total protein 6.9 gm. %; serum albumin 4.0 gm. %; serum globulin 2.9 gm. %; serum euglobulin 2.1 gm. %; serum pseudoglobulins .8 gm. %; serum carbon dioxide content 26.8 milliequivalents per litre; serum total halogen 95 milliequivalents per litre; serum sodium 128 milliequivalents per litre; serum alkaline phosphatase 5.5 Bodansky units %; serum cephalin flocculation (Hanger) 3 plus.

On May 18, the patient was examined again. He was then working about two days a week. He complained that he was barely able to pull through the day, owing to muscular fatigue. Prior to the accident, he had been able to work with ease. He appeared much less restless than on his first visit. His skin was a better color, normally moist; and the tremors had disappeared. Urinalysis: protein 2 plus; alkaline; amber; clear; sp. g. 1.022; sugar negative. Microscopic: numerous hyaline and epithelial casts and cylindroids. Blood count: hemoglobin 15 gm.; red blood cells 4 million; white blood cells 5.8 thousand; neutrophils 61%; lymphocytes 31%; monocytes 8%; platelets 180,000.

On December 20, he was re-examined. He was then working four days a week without physical distress. He stated that he preferred to work because it took his mind off his experience. His appearance was normal. Urinalysis: protein negative; amber; clear; alkaline; sp. g. 1.120; sugar negative. Microscopic: a few squamous cells. Blood count: hemoglobin 14.5 gm.; red blood cells 3.4 million; white blood cells 7.3 thousand; neutrophils 66%; monocytes 5%; lymphocytes 28%; eosinophils 2%. Chemical findings: blood sugar 102 mg. %; serum non-protein nitrogen 23 mg. %; serum uric acid 6 mg. %; serum total inorganic phosphorus 3.6 mg. %; serum cholesterol 200 mg. %; serum free cholesterol 55 mg. %; serum cholesterol esters 145 mg. %; serum total protein 7.2 gm. %; serum albumin 4.9 gm. %; serum globulin 2.3 gm. %; serum euglobulin 0.9 gm. %; serum pseudoglobulins 1.4 gm. %; serum carbon dioxide content 27.4 milliequivalents per litre; serum total halogen 102.5 milliequivalents per litre; serum sodium 141 milliequivalents per litre; serum calcium 5.1 milliequivalents per litre; serum alkaline phosphatase 2.8 Bodansky units per litre; serum cephaline flocculation (Hanger) negative.

On March 27, 1952, he was again examined. He stated he then felt perfectly well, and could put in a full day's work without fatigue—even overtime. He had no appearance of chronic disease, but his hair was gray and rather scant for a man in his prime. He no longer dwelt on his accident, and was cheerful. His urinalysis was normal. His blood count showed a hemoglobin of 16 gm. with a normal differential count and a normal platelet count. Chemical findings: serum non-protein nitrogen 27 mg. %; serum uric acid 5.6 mg. %; serum total protein 7.0 gm. %; serum albumin 5.0 gm. %; serum globulin 2.0

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gm. %; serum euglobulin .1 gm. %; serum pseudoglobulins 1.9 gm. %.

It is apparent from the foregoing that the patient suffered from severe involvement of his bone marrow with disturbances of his blood showing a rise in hemoglobin from 13 to 16 gm. and an increased platelet count ranging from 80,000 to 180,000. His urine showed 2 plus protein when first examined which entirely cleared up, and profuse casts which also disappeared. Following his kidney involvement the non-protein nitrogen dropped from 82 to 23 mg.%, the uric acid from 8.8 to 5.6 mg. %. The serum sodium rose from 128 to 141 milliequivalents, and the serum halogen from 95 to 102.5 milliequivalents per litre.

His liver showed considerable damage, with a Hanger test of 3 plus when first examined, which became negative. His bilirubin was 1.8 mg. % and dropped to .1 mg. %. His total cholesterol was 308 mg. % which became 200 mg. %. The protein partition where the globulin fraction was out of line returned to a normal ratio. The alkaline phosphatase, which was 5.5 Bodansky units, dropped to 2.8 Bodansky units.

This picture resembles that of a diffuse disease in the involvement of several systems. The mechanism responsible for the similarity is probably a stoppage of the ventricular contraction due to electric shock which throws the organ into spasm, and cuts off the general blood supply. The resultant ischemia of the various organs affected produces injury which gives the same chemical values in the acute stage as those arrived at in the more slowly developing diffuse diseases.

It may be assumed in the absence of an encephalogram, that the same process acting on the central nervous system gives rise to the tremors, sweating and apprehensive mental state, which so often results in a faulty diagnosis of neurasthenia.

## "The Boy With Two Hooks"

INDUSTRIALLY we are all misfits. It has been estimated that only 1% of the population are fit for all types of work. From the industrial standpoint, the absence of disease does not necessarily mean physical fitness. We all have physical limitations industrially. It is just a matter of degree. For all potential employees, old or young, with or without patent disabilities, the factors of personality, training, experience, temperament and all the other considerations that go to make up the individual are the elements that account for the success of anyone on the job. The so-called disabled worker varies as a commodity of employment only in that his physical disability must be matched to the demands of the job he is required to do. He varies, too, in that he has over-compensated skills which have been developed because of his disability. Does the typist have to pass an entrance physical examination equivalent to that which is required for a runner in a 100-yard dash, or can she sit with her dead legs in a wheel chair and do a day's work for a day's pay? Does the boy with two hooks to replace the hands he lost in an industrial accident, rate as disabled, from the industrial standpoint, when he dresses himself, travels alone on public transportation, feeds himself and satisfactorily handles his job in the experimental engineering shops of the Ford Instrument Company? We need no longer think of jobs as night watchmen, timekeepers, elevator operators and guards for our disabled millions. Some of our great companies have pioneered in employment of handicapped workers, not only during the last war, when so-called understanding was expedient because no one else was available, but since then. The International Business Machines Corporation now has nearly 500 severely handicapped persons working in its plants at Endicott and Poughkeepsie, New York. The 65 different jobs they perform represent practically every type of job in the IBM production. Analysis of its records shows that the average length of service with the company is longer than that of most employees; their job assignments are similar, their educational level is the same, and they are equally efficient on the majority of work assignments.

—From "Industry's Manpower Resources," by HENRY VISCARDI, JR., in American Mutual's *Loss Control*, August, 1951.

# "The Din of the Tumult of Things"
## — Something About Noise —

WILLIAM P. YANT is credited with naming it "The Acoustical Spectrum." "It" was the Inservice Training Course on "Sound—Wanted and Unwanted," given by the University of Michigan School of Public Health in collaboration with The Institute of Industrial Health, at Ann Arbor, February 5-8.

*A spectrum,* indeed!

But the Course was the Prism which made it a Spectrum. Without the capable planning of those who staged the proceedings, the sessions might easily have netted only a run-of-mine symposium. And without the clear "white" of the assembled brains of the lecturers, the participants, coming to learn about "sound," might easily have been favored with little else. The planners, however, knew what was needed, and the lecturers supplied it. The result was the complete Spectrum of Sound—as fundamental in its essentials as the primary colors, while shading off to all their combinations from faint to vivid. No phase of sound, no nuance of its implications, was left unexplored; and each voyager into even its remotest area came back treasure-laden. Throughout the four-day sessions, the great names of Sound—ANSON, BERANEK, BONVALLET, CREDE, FUGILL, GLORIG, GOLDMAN, GUILD, HOUSE, KINNEY, KNUDSEN, KOBRAK, KRYTER, JACK, LANE, NASH, PARRACK, SABINE, STERNER, SYMONS, WHEELER—traversed the gamut of the relations of sound wanted and unwanted to physiology, physics, psychology, architecture, industry, law, and economics; and whether the listener was physician, executive, hygienist, engineer, manager, health officer, lawyer, worker, student, he sat unmoving except to applaud, absorbed except for hasty notes against the looming certainty of too much to remember. The lectures were uniformly superb—well planned, well ordered, logical in presentation, and, above all, clear and understandable to the non-technical reader, while containing a liberal education for even the technician. "Acoustics touches, overlaps, or cuts across many disciplines."

ON A PAR with the quality and completeness of this Course in importance to industry, was its timeliness. In the opinion of many, the matter of noise deafness is about to break over industry's head with even more dire potentials, in the form of claims, than those with which the silicosis racket exploded 20 years ago. Compensation authorities are faced with the fact that noise deafness is a present reality, not a more or less remote possibility. And already many difficulties have arisen as to the methodology of its appraisal. "What is disability in connection with partial deafness? Should compensation be paid for physiologic disability in the absence of economic disability? Some deafness is a work asset. What about the significance of the well-known slowly-developing deafness of senility? How can noise deafness be set apart or rated in the midst of the probability of senile deafness wholly unrelated to noise? How much recovery in hearing may arise after removal to non-noisy work? How may the degree of hearing loss be measured? How many industries may be destroyed if riotous programs of compensation payments appear?" "All the wisdom of the law and medicine" is involved in the answers. There is almost a deluge of answers in these lectures, and their value is greatly enhanced by the fact that they are made available at exactly the right time.

NOISE is ubiquitous; the "din of the tumult of things" is with us everywhere and all the time; the day when one who desires to "go into the silence" may not be able to do so without ear defenders is already a close tomorrow. But "noise may satisfactorily be routed whenever man wants this boon." And this Course on "The Acoustical Spectrum," more than anything of the kind that has ever been given, offers man the "know-how" of routing it whatever his angle of approach.

Unfortunately for our ability to bring this Course to our readers, the 25 lectures would fill half-a-dozen issues of this Journal to the exclusion of all else. We are able, however, to include three of the lectures in the following pages. The first is DR. PARRACK'S "Ultrasound and Industrial Medicine," in which the author removes "the legendary and the mysterious from the body of popular 'information' about the action of ultrasonics on man." The second is DR. STERNER'S "Standards of Noise Tolerance," in which there are many wise words. The third is DR. NASH'S "Medical Aspects of Industrial Hearing Loss," in which this sentence appears: "With genuine sincerity management has said that if 730 claims for industrial deafness were awarded as they come up for hearing, the plant, which is not a large one, will have to close, for it cannot compete in the open market with concerns that have no problem of industrial deafness." These articles are reprinted here, by permission, from the 200-page Book, titled "The Acoustical Spectrum," just published by the University of Michigan School of Public Health, containing the full Course on Sound, and procurable through the School at Ann Arbor. In an early issue we plan to republish also the lecture by NOEL SYMONS on "Trends in Compensation Attitudes." Even though this deals with alleged and actual noise deafness, it is not mixing metaphors to characterize MR. SYMONS' lecture as a real "eye-opener."

—G. R.

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# Ultrasound and Industrial Medicine

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THE examination of the facts about ultrasound is a fascinating assignment—it leads one into so many nooks and crannies of science and general human knowledge. To contemplate the realm of possible applications of ultrasound (ultrasonics) is exciting—to borrow from the movie world, it is stupenduous! There are few fields in which applications of ultrasound do not already exist. Ultrasound has been applied as a research tool in physics, chemistry, metallurgy, materials, general biology, bacteriology, physiology, sanitation, surgery, and medicine. In many of these fields extensive applications have been made to practical industrial processes. Yet, these are only beginnings—the science is, as yet, essentially newborn.[1,3,9] The science had its beginning about 1914, but extensive development did not start until about 1930.[9] The growth has been unbelievably rapid, as is indicated by the fact that Reference 3 lists over 1300 titles up to 1939, and that of the 580 titles listed in Reference 7 (biological fields) only three were published before 1927. The present rapid growth of the science of ultrasonics is indicated by the fact that one journal alone, the *Journal of the Acoustical Society of America*, lists 20 or more titles in this field in each issue.

It is clear that one could not hope to cover so large a field of science in a single lecture. This is one reason why I have limited myself to that very small part of the field of ultrasonics which deals with biological phenomena, and in this area shall consider almost exclusively those problems in which the sound is transmitted to the biological system through air. A second reason for concentrating on these parts of the general field is, that in these areas are found the major misconceptions which are of importance to persons concerned with public and industrial health.

The origins of these misconceptions are not entirely clear. One hears, repeated many times, the statement that incidental exposure to ultrasonic waves results in neuromuscular incoordination, loss of ability to do mathematical problems, and even complete loss of capacity to perform a voluntary act. I have not been able to establish a reliable source of any of these statements. Nevertheless, they persist in the minds of large segments of our population.

With the development of jet propulsive devices for airplanes, new disabilities were added to the list. These include, nausea, vomiting, excessive fatigue, headache, and increased irritability. All these pathological reactions are said to be effects of exposure to the ultrasonic components in the sound fields generated by the jet engines. It has been difficult to determine why the ultrasonic components were assigned responsibility for these undesired reactions of man. The only clue is that the physicists who made the earliest measurements on these ultrasonic fields stated that the levels were high enough to be damaging to the ear if the sound waves were audible. Apparently, later quotations of these conclusions neglected the qualifying phrases, and the stories of the mysterious actions of ultrasonics grew.

Although it has been difficult to establish the origin of these ideas it is not difficult to understand their persistence. Our population is greatly interested in scientific matters—it is especially interested in airplanes and flying. Therefore, anything having to do with ultrasonics or "supersonics," when it could be associated with aviation, has been newsworthy. Many newspaper and magazine[10,11] articles have appeared in which the spectacular aspects of ultrasonics have been described. In these necessarily limited presentations it has been impossible to assemble all of the facts. Misconceptions arose and spread rapidly because of the popular interest in all things connected with flying.

The result is a widely disseminated body of "so-called facts"—partly truth, partly legend. Upon hearing or reading these various stories one reasonably may ask—Supersound? Shall it cure or kill? Or, indeed, one may justifiably exclaim: "There's an airplane overhead, we shall all be ill!" It is our purpose here to ask—What is true? Who is right?—and remove the legendary and the mysterious from the body of popular "information" about the action of ultrasonics on man.

## Definitions

ONE reason for misunderstandings and the growth of misconceptions is the failure to establish definitions, clearly understood by all, before a discussion is held. Many of the misconceptions concerning the action of air-borne ultrasound arose because the results of certain experiments were publicized without defining the conditions under which the results were obtained. To avoid possible misunderstandings here, we shall now define a few of the terms to be used.

*Sound—Sound Waves:* (a) Sound is an alteration in pressure, stress, particle displacement, particle velocity, etc., which is propagated in an elastic material, or the superposition of such propagated alterations; (b) Sound is also auditory sensation which is usually evoked by the

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alterations described above.[12] (*Note:* In case of possible confusion, the term "sound wave" or "elastic wave" may be used for concept (a), and the term "sound sensation" for concept (b).)

*Acoustics:* "Acoustics is the science of sound including its production, transmission and effects."[12]

*Wave:* "A wave is a disturbance which is propagated in a medium in such a manner that at any point in the medium the displacement is a function of the time, while at any instant the displacement at a point is a function of the position of the point. Any physical quantity which has the same relationship to some independent variable (usually time) that a propagated disturbance has, at a particular instant, with respect to space, may be called a wave."[12]

*Oscillation (Vibration):* Oscillation is the variation, usually with time, of the magnitude of a quantity with respect to a specified reference when the magnitude is alternately greater and smaller than the reference."[12]

*Periodic Quantity:* "A periodic quantity is an oscillatory quantity, the values of which recur for equal increments of the independent variable. If a periodic quantity, y, is a function of x, then y has the property that

$$y = f(x) = f(x + k)$$

where k, a constant, is a period of y. The smallest positive value of k is the primitive period of y, generally called simply the period of y."[12]

*Cycle:* "A cycle is the complete sequence of values of a periodic quantity which occur during a period."[12]

*Frequency:* "The frequency of a periodic quantity, in which time is the independent variable, is the number of periods occurring in unit time.[12] (*Note:* Unless otherwise specified, the Unit is the cycle per second.)"

*Fundamental Frequency:* "The fundamental frequency of a periodic quantity is the frequency of a sinusoidal quantity which has the same period as the periodic quantity."[12]

*Audio Frequency:* "An audio frequency is any frequency corresponding to a normally audible sound wave. (*Note:* Audio frequencies range roughly from 15 to 20,000 cycles per second.)"[12]

*Infrasonic Frequency (Subsonic Frequency):* "An infrasonic frequency is a frequency lying below the audio frequency range."[12]

*Ultrasonic Frequency (Supersonic Frequency):* "An ultrasonic frequency is a frequency lying above the audio frequency range. The term is commonly applied to elastic waves propagated in gases, liquids or solids."[12]

*Static Pressure:* "The static pressure at a point in a medium is the pressure that would exist at that point with no sound waves present. In acoustics, the commonly used unit is the microbar."[12]

*Microbar:* "A microbar is a unit of pressure commonly used in acoustics. One microbar is equal to 1 dyne per square centimeter."[12]

*Instantaneous Sound Pressure:* "The instantaneous sound pressure at a point is the total instantaneous pressure at the point minus the static pressure at that point. The commonly used unit is the microbar."[12]

*Effective Sound Pressure (Root-Mean-Square Sound Pressure):* "The effective sound pressure at a point is the root-mean-square value of the instantaneous sound pressures, over a time interval at the point under consideration. In the case of periodic sound pressures, the interval must be an integral number of periods or an interval long compared to a period. In the case of non-periodic sound pressures, the interval should be long enough to make the value obtained essentially independent of small changes in the length of the interval."[12]

*Sound Pressure Level:* "The sound pressure level, in decibels, of a sound is 20 times the logarithm to the base 10 of the ratio of the pressure of this sound to the reference pressure. The reference pressure shall be explicitly stated.

(*Note* 1: The following reference pressures are in common use:

(a) $2 \times 10^{-4}$ microbar
(b) 1 microbar

Reference pressure (a) has been in general use for measurements dealing with hearing and sound level measurements in air and liquids, while (b) has gained widespread use for calibrations and many types of sound level measurements in liquids.)

(*Note* 2: It is to be noted that in many sound fields the sound pressure ratios are not proportional to the square root of corresponding power ratios and hence cannot be expressed in decibels in the strict sense; however, it is common practice to extend the use of the decibel to these cases."[12])

*Sound Absorption*: "Sound absorption is the process by which sound energy is diminished in passing through a medium or in striking a surface."[12]

*Ultrasonics:* "Ultrasonics is the general subject of sound in the frequency range above about 15 kilocycles per second."[12]

*Supersonics:* "Supersonics is the general subject covering phenomena associated with speed higher than the speed of sound (as in case of aircraft and projectiles traveling faster than sound)."[12]

## A Little History

EARLY GENERATORS OF AIR-BORNE SOUND: It was known as early as 1899 that ultrasonic waves could be set up in air.[1] Koenig[13] produced ultrasonic waves at frequencies up to 90,000 cycles per second by means of tuning forks. These waves are small in amplitude and rapidly damped in air, so that they are of little practical usefulness.

Ultrasonic waves of greater importance are generated by the Galton Whistle, as designed by Edelman (1900), and which has been used widely for physiological studies. This device, when well designed, generates air-borne sound waves which are very constant in amplitude and frequency up to about 100 kilocycles per second.

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Another useful generator of ultrasonic waves in air is the Hartmann Whistle (1927). In air these generators produce frequencies up to about 120 kilocycles per second at relatively large pressure amplitudes. We used a model of this generator rather extensively in the laboratory before the large siren was available and find it useful, still, for demonstrating ultrasonic waves in air.

Holtzmann in 1920 described a method for generating ultrasonic frequencies in air by means of a glass rod forced into vibration by a mechanical method. The sound is radiated from the free end of the glass rod which is vibrating in the longitudinal mode.

Other sources of ultrasonics are the thermal generators, of which the spark gap generator of Altberg[1] and the Dieckmann pulsating arc generator are examples. Frequencies of 780 kilocycles per second or higher can be generated.

In the more recent studies, using ultrasonic waves in air, various types of sirens have been employed as the generators. One such siren was described by Allen and Rudnick[14] in 1947. A siren based on similar principle but of different design has been used in our studies on the effects of air-borne ultrasound. This siren produces sound waves in the frequency range 1 to 150 kilocycles per second.

GENERATORS OF SOUND IN LIQUIDS—WATER: The modern science of ultrasonics can be said to have been born with the work of Langevin and Chilowsky (1914, and following) on the production of under-water sound waves for detecting submerged objects.[15] Their first generator was a condenser-transducer, and with it a transmission distance of 2000 yards was finally attained. Langevin later developed a transducer consisting of a thin quartz crystal sandwiched between two steel plates. This constituted a resonant electromechanical system and increased the amplitude of the sound signal many fold. These developments were the first of a series of developments which resulted in many different transducer designs employing crystals, magneto-strictive materials and magnetic devices as the units for converting electrical waves into sound waves. Many of these have been employed for setting up sound waves in gases, liquids, and solids.

EARLY OBSERVATIONS ON BIOLOGICAL EFFECTS: Since the early generators of ultrasound were largely used in water it was natural that observations should be made of the effect of the sound waves on fish and other animals inhabiting the water. Little systematic study was made of the biological effects of ultrasound until 1927 when the paper by Wood and Loomis was published.[16] This report described laming and death of small fish, and frogs, disruption of plant cells and protozoa and hemolysis of blood cells. It stimulated considerable interest in this field.

Harvey[17] was one of the first investigators to study the action of ultrasonic waves on living material observed under the microscope. He reported the following effects: whirling of protoplasm, displacement of small particles, stimulation of activity, and, finally, disintegration of intracellular bodies and cytolysis. Many later observations have been made by others, showing similar effects and extending the range of organisms studied. In nearly all of these studies the organisms were exposed to the sound waves in liquid. Few studies were made using air-borne ultrasound, perhaps because the available generators did not set up sound waves in the air of sufficient energy content to be effective on the biological specimens. It is not possible to survey all of the biological studies here but the general bibliographies given in this paper will provide many sources of information about the results of the early work as well as information about the results of more recent investigations of the biological effects of ultrasound.

## The Media

OWING to differences in the physical constants of the different media, air, water, and solids the propagation of the sound in these media may differ markedly. The velocity of propagation in air is 331 meters per second, while in fresh water it is 1430 meters/second, and in metals such as aluminum and steel it is about 5000 meters/second. Other factors such as absorption, dispersion, etc., vary with the media in which the sound wave is propagated. Furthermore, the efficiency with which sound sources (ultrasonic generators) transfer energy into these media varies greatly. Most of the usual sources of ultrasound are very inefficient when used to set up sound waves in air. For this reason sirens or other devices which modulate an air stream are used when intense ultrasonic waves are to be set up in air. Various types of propulsive devices such as turbo-jet engines are good generators of air-borne sound, because in their normal operation streams of gases moving at high velocities are modulated. In most of the recent studies directed toward the determination of the action of air-borne ultrasound, sirens have been used as sources. In many of the incidental or "accidental" studies jet power plants have been the sound sources.

## Air-borne Ultrasound

INTEREST in air-borne ultrasound and its effects on living organisms, particularly man, developed rapidly as jet propulsive devices for aircraft came into use. As mentioned earlier, several disabling or partially disabling effects were ascribed to the action of the ultrasonic waves in the noise fields generated by jet power plants. To study the effects of air-borne ultrasound under controlled conditions, sirens were developed as sources. These sources produced ultrasonic waves at pressure levels of about 160 db reference 0.0002 microbar in the low ultrasonic frequency range, and levels above 140 db reference 0.0002 microbar at frequencies around 150 kilocycles per second. Most of these sirens could

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generate even more intense sound waves in the audio frequency range.

Turbo-jet engines produce a wide-band ultrasonic spectrum in contrast to the sirens which generate only one frequency at a time. The level of these ultrasonic components of the jet engine noise field has always been found to be less than 100 db reference 0.0002 microbar. However, the range of frequencies produced is large, and components at frequencies as high as 250 kilocycles per second have been detected. These aircraft power plants are, therefore, a good source of ultrasonic waves but they are even better sources of sound waves in the audio frequency range.

## Ultrasonic Sickness

PERSONNEL working around jet power plants complained of excessive fatigue, headache, nausea, vomiting, loss of neuro-muscular coordination, extreme irritability, and other symptoms. This complex of symptoms soon became known as "ultrasonic sickness." At about this time the work of Rudnick, Allen and Frings[18,19] was publicized through popular news magazines and "ultrasonic sickness" became a dire threat and engendered great fear among personnel working with turbo-jet engines. In an effort to evaluate the factors responsible for "ultrasonic sickness" our experiments with ultrasound were performed.

## Some Experiments with Air-borne Sound

LET US recall that the early work on living organisms (experimental subjects immersed in water or other liquid) using ultrasound had shown that death and destruction were easily accomplished. Now, when ultrasonic energy was found in the air-borne sound field of jet engines the general population transferred the data for the liquid immersed experimental animals to the air immersed man and concluded that the noise fields of jet engines were likely to be lethal. When it was shown that mice were rapidly killed[18,19] in air-borne ultrasonic fields this belief grew, and fear of these noise fields became a serious problem in the whole aviation industry. Rudnick and his co-workers had deliberately not exposed men to their sound fields. The equipment was not suitable, and their major interests were centered on other matters. Therefore, it was necessary to perform specific experiments to determine the action of air-borne ultrasound on man. I should like to discuss those experiments.

Our experiments were initiated by repeating the work of Rudnick *et al*, using rats and guinea pigs as experimental animals. We found that these animals could be killed easily in air-borne ultrasonic fields. We also found that they could be killed as easily in sound fields of the audio frequency range down to 1000 or 2000 cycles per second. There was nothing mysterious or special about the ultrasonic fields. Measurements of fur and rectal temperatures showed that when

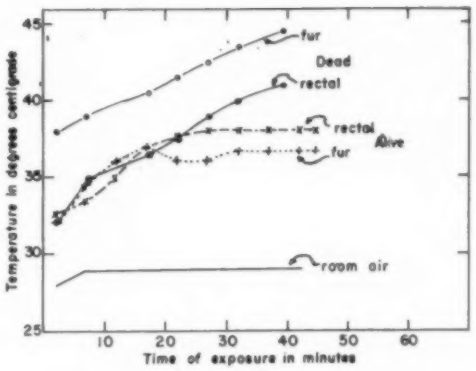


Fig. 1.
Comparison of the rise of fur and rectal temperatures with increasing duration of exposure. Rats exposed to intense sound fields in air. Observe that animals remained alive when an equilibrium was established at moderate fur and rectal temperatures.

death occurred, fur and rectal temperatures rose as the exposure time increased, as shown in Fig. 1. It was also found that when the animals survived the exposure, the fur and rectal temperatures became stabilized as shown in Fig. 1 (alive). These results suggested heating of the animal as the cause of death.[20] Animals were now exposed to a heat source (therapeutic lamp), and when the distance between the lamp and animals was properly adjusted the animals died in the same time and showed the same rectal and fur temperature relations that were found in exposure to the sound field. Furthermore, examination of the animals showed identical gross pathology for the exposure to the two different sources of energy. These data confirmed Rudnick's experiments, in which he showed that mice, immersed in water at the same temperature as the average fur temperature of the animals exposed to sound, died in the same length of time and showed the same rectal temperatures that were measured in exposure to sound. Apparently death was primarily the result of overheating produced by the absorption of sound energy by the animal's fur. The sound pressure levels required to produce death were always 152 db reference 0.0002 microbar or greater.

Now it happened that a human observer was required in making our experiments. He was in the same sound field as the animals and suffered no ill effects. These results suggested that additional experiments should be performed on animals and men in order to explain the very different responses to the sound field.

A series of experiments were performed in which the absorption coefficients of the surface of the ratio body were measured.[20] A summary of the results of these experiments is given in a generalized way in Fig. 2. In this figure the trends of the absorption coefficients of the rat's body surfaces are shown: one curve shows the variation in absorption with frequency for the

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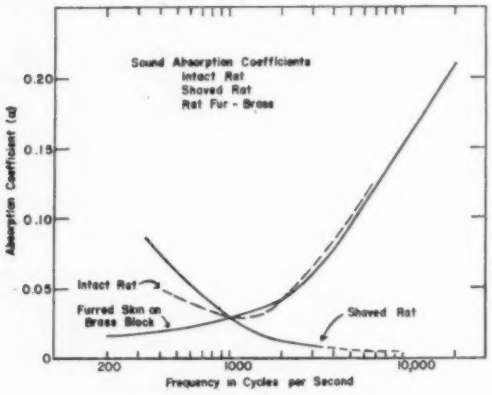


Fig. 2.

Comparison of the absorption coefficients of the surface of a rat's body, and of the furred skin. Data are for (1) intact furred animal; (2) intact animal hair removed from skin and; (3) furred skin of animal supported on a solid brass block.

intact animal; a second curve shows the results of shaving the animal; and a third curve shows the behavior of the furred skin when removed from an animal and supported on a brass block. The intact animals shows high absorption at low frequencies, a minimal absorption of sound at about 1500 cycles per second, and at higher frequencies a continually increasing absorption throughout the frequency range measured. The absorption by the shaved skin is greatest at low frequencies and decreases as the frequency increases. The fur on a brass block starts with minimal absorption at the lowest frequency studied and the absorption increases steadily as the frequency increases. The rise in the absorption at the low frequencies in both furred and shaved intact animals is attributed to transmission through, and re-radiation of these low frequency sound waves by, the animal's body. The actual value of the absorption coefficient varies

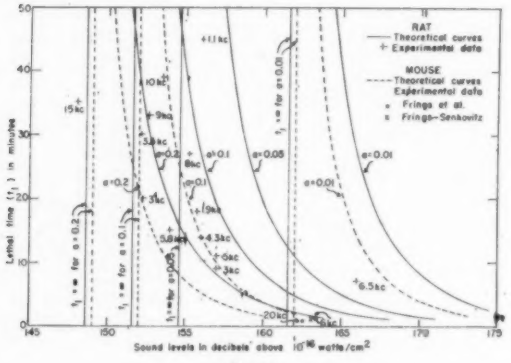


Fig. 4.

Lethal time as a function of sound intensity. Data are for the furred rat and mouse. Range of absorption coefficients is from 0.20 to 0.01. Curves drawn are for theoretical data. Points indicate experimentally observed data.

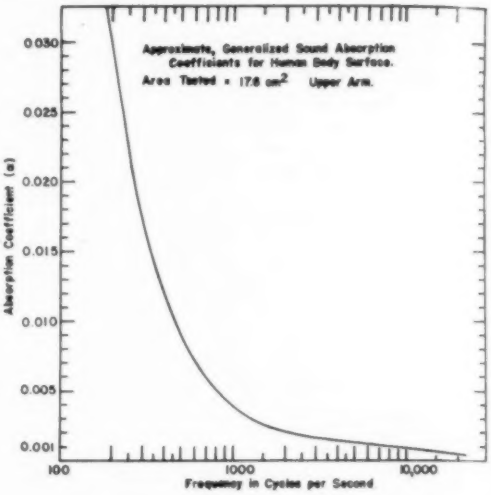


Fig. 3.

Absorption coefficients for sound, surface of human body. Generalized curve indicating the variation of absorption with frequency and the order of magnitude of the coefficients. Compare with Fig. 2.

from animal to animal, and is in part dependent on fur length. However, these generalized curves indicate not only the trend of the absorption but also the correct order of magnitude of the absorption coefficient.

A similar series of experiments were performed on the surface of the human body.[21] The results of these experiments are summarized in Fig. 3. The absorption coefficient of the human skin (upper arm) is shown as a function of frequency. Observe that the absorption is slight compared to that of furred animals, that it is greatest at low frequencies and decreases rapidly with increasing frequency to reach a very low value at ultrasonic frequencies. Comparing the two sets of data, we have at 10,000 cycles per second, for the rat about 15% of the incident energy absorbed and for man only about 0.1%.

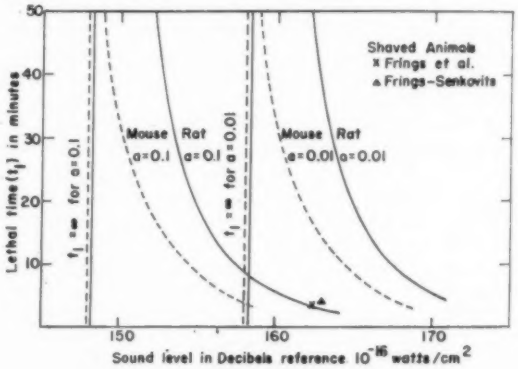


Fig. 5.

Lethal time as a function of sound intensity. Data are for shaved animals (rats and mice). Absorption coefficients between 0.10 and 0.01 are considered.

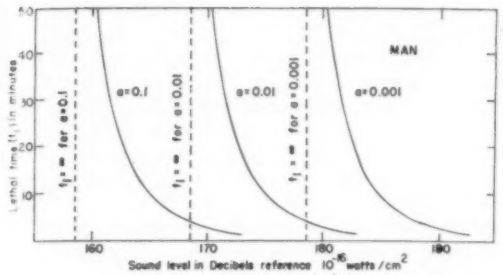


Fig. 6.
Estimated lethal time (overheating) for man as a function of sound intensity. Absorption coefficients from 0.10 to 0.001 are considered. No experimental data exist with which to compare these calculated values.

His absorption coefficients alone offer man a great deal of protection, in comparison with rats or mice, exposed to air-borne ultrasonic waves.

## Calculation of Lethal Time

EMPLOYING the data on absorption coefficients and other data available in the literature, it is possible to calculate sound levels which will be lethal and also the time required for a sound field, above a certain minimal measure level, to kill animals.[20] These calculations have been made and the results for furred animals (rats, mice) are summarized in Fig. 4. In this figure *lethal time* in minutes is plotted against the sound pressure level in db reference $10^{-16}$ watts/cm². Absorption coefficients ranging from 0.20 to 0.01 are considered by the data presented. The data show: (1) that with a given absorption coefficient there is a sound level below which animals will never be killed; (2) that when this threshold lethal level is reached death occurs very much more rapidly as the sound level increases; (3) that furred animals such as rats and mice (absorption coefficients for their fur as measured) should not be killed in air-borne sound fields below about 150 db reference $10^{-16}$ watts/cm² in level. Experimentally we never could kill an animal with sounds below 150 db in level. The experimental data are also entered on this figure.

Similar calculations were made for the shaved animals and these data are shown in Fig. 5. The same general relationships hold but since the absorption coefficient of the shaved animal is much smaller, 0.01 as compared to 0.15 at 10,000 cps the practical sound levels required to kill are much higher for shaved animals.

One may make similar calculations for man. Such data are presented in Fig. 6. Since man's absorption coefficient in the ultrasonic frequency range is quite small (0.001 or smaller) the practical sound levels required for killing are very high, of the order of 180 db or greater. Furthermore, man's greater volume and more efficient heat dissipating mechanism contribute to his safety in intense sound fields.

If we now compare the sound levels required

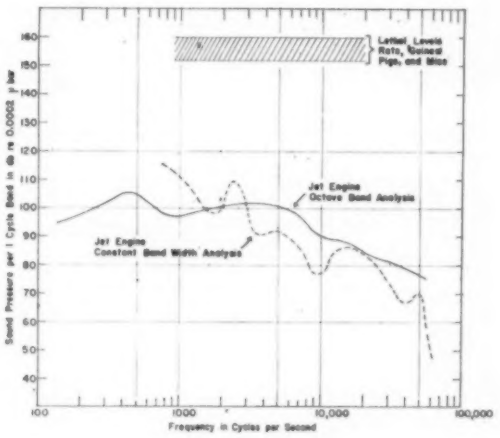
Lethal Levels Rats, Guinea Pigs, and Mice
Jet Engine Octave Band Analysis
Jet Engine Constant Band Width Analysis
Sound Pressure per 1 Cycle Band in db re 0.0002 μ bar
Frequency in Cycles per Second

Fig. 7.
Sound pressure level in bands one cycle per second wide generated by turbo-jet power plants. These levels are plotted as a function of frequency. Compare with range of lethal levels—cross hatched area at top of figure.

to produce lethal effects in man with the level of the ultrasonic components of power plant noise fields we can predict the relative safety of personnel working near these devices. Data on the sound levels generated by turbo-jet engines, plotted as pressure level in bands one cycle per second wide are shown in Fig. 7. Here, we see that no ultrasonic component of the noise field is higher in level than about 98 db reference 0.0002 microbar. These levels are of the order of 80 db below the levels required to kill man exposed to ultrasonic sound waves. This means that sound pressure 10,000 times greater than that produced by jet power plants, in the ultrasonic frequency range, is required to reach the minimal lethal level at infinite exposure time. We may therefore conclude that personnel working near these power plants are in NO DANGER, with respect to the heating action of air-borne ultrasound.

We may now consider the effects of these ultrasonic components on personnel located at greater distances from the power plants. These may be persons who live in areas adjacent to flying operations or persons working in parts of a facility which are far removed from the operating aircraft. In this case the same noise levels are generated as discussed above but these levels are further reduced in propagation to distant locations by: (1) the effect of the sound wave spreading into larger portions of space; and (2) by attenuation in the air. The attenuation in db per foot of propagation pathway is plotted as a function of frequency in Fig. 8. Here we see that the measured attenuation per foot for a frequency of 15,000 cycles per second is approximately 0.12 db when the environmental conditions are; relative humidity 37%, temperature 26°C. This will result in a reduction of 12 db

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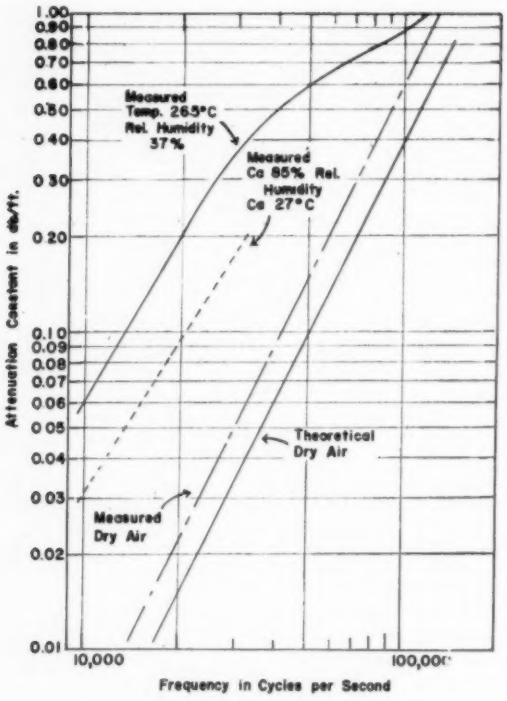


Fig. 8.
Attenuation of sound in transmission through air. Compare effects in dry air versus air containing various amounts of water vapor.

at a point 100 feet from the engine. The level generated by engines at this frequency is approximately 85 db (Fig. 7) and the exposure level for a person 100 feet from the engine would be not more than 73 db or over 100 db below the lethal level. We can conclude that persons at a distance from these power plants will not be endangered by the ultrasonic components of the noise field. It would appear, then, that the ultrasonic components of airplane propulsive devices are harmless for all persons who may be exposed to them.

It cannot be concluded that the noise fields of these power plants are not hazardous, because they also contain components at audio frequencies which are high enough in level to injure the ears and perhaps cause other disturbances to physiological functions of exposed personnel. But we are familiar with the effects of these sounds and are not unduly frightened by them. Protection is necessary, but it must protect against audio frequency sound waves. In general we summarize these facts by saying that, what you don't hear—won't hurt you!

We may perhaps go one step further and examine the probability of damage from air-borne ultrasound produced by sources other than aircraft power plants. Almost all of the effective generators of ultrasound in air produce the sound by modulating an air stream. These sources of ultrasound are seldom employed industrially and when so employed the sound waves are generated into a closed space. There seems to be little chance that any of these devices will create a hazard. The only probable hazards are when the devices are used for experimental purposes and then the levels must be extremely high. It is not probable that a real hazard exists in connection with their use.

Other types of generators are not efficient in setting up ultrasonic waves in air. The usual devices employed industrially will not produce intense ultrasonic air-borne waves. Such waves as are set up will be attenuated rapidly. There can be little, probably no, hazard to man from the operation of equipment of this type when the sound wave is transmitted to man through air.

## Liquid- and Solid-borne Ultrasound

ULTRASOUND and ultrasonic generators are being employed more and more extensively daily. These generators are of many types but usually the ultrasonic wave is set up in liquids or solids or in gases within a rigid container. As has already been indicated, the danger to man from air-borne ultrasound from these devices is slight. However, there are situations where the ultrasound may be transmitted to man through a liquid or solid medium. In such cases the data already discussed do not apply. We shall now examine some of these applications of ultrasonics in respect to the possible damaging action of the sound wave transmitted to man's body.

## Laboratory-Experimental Uses

ULTRASONIC generators are frequently used in many experimental laboratories. In many cases the personnel using this equipment may make adjustments or perform other operations on the equipment or the material to be exposed which bring them in direct contact with parts of the generator. Other manipulations may bring them in contact with the liquid or solid materials subjected to irradiation. Such direct contact between the body surface and the liquid or solid under test allows relatively large quantities of ultrasonic energy to enter the body tissues. The conditions for transfer of energy from the medium in which ultrasound is propagated, into the human body are more favorable when the medium is a liquid or a solid instead of air. In addition many of these laboratory generators, designed for experimental work, are not constructed so that possible contact of the operator with the equipment is minimal. Operation of experimental equipment offers opportunities for transfer into the body of sufficient energy to damage tissues unless care is exercised in handling the equipment.

The operation of experimental equipment is, therefore, a possible hazard which is of interest to industrial medical personnel. Information is

not available which permits a determination of the degree or extent of this hazard. Under these circumstances one can only say that such operations should be carefully watched, and upon the first indication of any damage to the experimenter the whole operational process should be studied and the necessary protective measures taken. Isolation of the operator by means of an air layer and arranging the equipment so that no direct contact of the operator with the generator or the material under study should provide the safety required. When the frequencies employed are in the high ultrasonic range 500,000 cps to several megacycles per second, air is an excellent medium for isolating the human operator from the equipment.

### Industrial Applications of Ultrasound

ULTRASOUND equipment is being used more and more extensively in industrial situations. It is used to detect flaws in materials, to determine certain properties of materials, to secure dispersion of solids in liquids (emulsion), for agglomeration of particles from liquids and gases, and many other jobs. Many of these operations are so arranged and the equipment is so designed that there is little chance for direct contact of the operator with the generator or the material under test. In these cases there appears to be little chance that a hazard to personnel exists. However, certain other operations, such as removing grease from metals and other cleaning processes employing ultrasonic energy, may require direct contact of the attendant with the irradiated material. There is certainly a probable hazard in such operations. It will be necessary for the industrial medical personnel to watch such operations, and require utilization of methods including the use of protective equipment which prevents contact between any part of the operator's body and the generator or material being irradiated. Exercising reasonable care in process layout and utilization of protective equipment should remove any hazards that may be present.

### Medical Applications and Possible Hazards

ULTRASOUND is being extensively used in biology and medicine. The applications of ultrasound can be classified under two general headings: (1) experimental studies using ultrasound, and (2) therapeutic methods utilizing ultrasound. The literature in these biological fields is already extensive, and more work is undertaken daily. No attempt will be made to cover this subject in detail, but general features will be indicated, together with suggested sources of further information.

### Experimental Studies Employing Ultrasound

THE experimental studies in which ultrasound is employed usually have one of the following purposes: (1) the determination of the physical properties of the tissue studied; (2) the determination of the mechanisms by which ultrasonic energy produces an effect on biological material; (3) the determination of the effect of ultrasound on physiological functions of tissue; (4) the ultrasound is used as a tool to perform localized injury or destruction of tissue for the purpose of evaluating the *usual* function of the tissue area destroyed, or rendered non-functional. Frequently all purposes mentioned are combined in the same experiments, but, more commonly, purposes (1) and (2) above are combined, and purposes (3) and (4) are combined.

Recent studies in one or more of these fields include: (1) studies on the effects of ultrasonic energy on nervous tissue;[22,23,24,25] (2) an evaluation of ultrasonics in relation to medicine;[26] (3) studies on temperature effects on bone and surrounding tissue.[27] In these experiments the ultrasonic energy is used as a tool, and the ultrasonic generators are simply necessary items of equipment. In respect to their place as possible hazards to operators, they are to be classified as possible hazards if not properly handled.

Some of the studies have been aimed at the production of changes in the structure of tissues —both physical and chemical structure. In this work ultrasonic energy is simply a tool.

Other studies have been directed toward the separation of the mechanisms producing the action on tissue. One effect that always accompanies ultrasonic irradiation of tissue is the production of heat. Heat can cause damage, and it has been said that all effects of ultrasonic energy are the results of overheating. The results of some of the experiments cited above indicate that there are effects producd by the ultrasonic irradiation which are not produced by heat. These effects are produced when heating is controlled.

It has been found that ultrasonic energy can be applied under controlled conditions so that it will act selectively on certain tissues. This makes possible studies of the function of those tissues that can be selectively damaged or rendered non-functional, particularly studies on the nervous system.[28] Ultrasonic energy appears likely to become a very useful tool in biology and its use will probably increase greatly.

### Diagnostic Uses

BECAUSE various tissues and body structures have different capacities for reflecting or absorbing ultrasound it may be possible to utilize these effects in localizing or determining the dimensions of these structures. Foreign bodies or crystal secretions located in some part of the body may possibly be located by the application of ultrasonic waves. These applications are essentially diagnostic.

Two such attempts of considerable interest may now be mentioned. One interesting application of ultrasonics has been made in attempting to develop a method for obtaining a ventriculogram (human brain) without using operative procedures or the injection of gases into the

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central nervous system.[29] Reasonably satisfactory ventriculograms have been obtained, and the method shows considerable promise.

Another application has been made in devising a method for localizing gall-stones in the human body.[30] This application seems to be feasible practically, and certainly would be of great use in localizing foreign bodies in the human body.

## Therapeutic Uses

ULTRASONIC energy has been used for various therapeutic purposes. The applications have been made most rapidly in Germany. There is still much uncertainty as to its effectiveness. This problem is reviewed in Reference 26. Certainly much caution should be exercised in therapeutic applications until it is established: (1) that ultrasound is an effective agent, and (2) that it can be applied in such a manner that it will not produce unexpected damage. Most American investigators have found that the therapeutic effect is uncertain, and that the hazard in the form of excessive exposure and destruction of tissue is considerable. It remains to be seen whether ultrasonic energy is important as a therapeutic agent.

The use of therapeutic equipment, where an operator may be in contact with the generator for several hours each day is probably hazardous unless protective equipment is used. Burning of the skin and other undesired actions on operators have been indicated in the German reports. If the use of the equipment becomes extensive, this will be an area requiring careful scrutiny. At present the degree and extent of the hazard cannot be stated.

I believe we can state that ultrasound applied to living structures through media other than air will be important in many experimental studies. The importance of ultrasonic energy as a therapeutic agent is uncertain. There are possible hazards to man in using this equipment, but the control of such hazards should be easily achieved.

## Summary

WE HAVE reviewed the growth of the science of ultrasonics. The question of the damaging action of air-borne ultrasonics has been discussed, and it has been concluded that there is *no hazard.*

The possible applications of ultrasonics for experimental, industrial, biological, and medical purposes have been briefly reviewed, and an assessment of the possible hazards to man has been made. It is concluded that a probable hazard exists, and that the hazard will increase as the use of ultrasonic generators increases. However, control of these hazards should be a relatively easy job.

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# Standards of Noise Tolerance

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AT THE present time there are about 200 physical and chemical agents of industrial significance for which standards specifying the maximum allowable concentration or exposure have been proposed. The reliability, the degree of acceptance by industrial health personnel—or, even more pertinent, by those industrial units which have no health personnel, and the actual extent to which these values are being used vary tremendously. Since "standards" mean many things to many people, and since "acceptance" and "compliance" are inexorably related to such definitions, it is as essential to qualify the purpose of the criteria as it is to assign a number.

To some a standard, or standards, for noise means merely a guide or a benchmark for testing against the great variety of noise conditions actually encountered in industry. To others it may have a gradation of significance up to a rigidly fixed value which implies a high degree of certainty that injury to hearing will occur not too far above the level, and safety for prolonged exposure can be expected below this figure. Certainly, at or near this latter point, the standard would connote a reliability which would justify, to many, its incorporation in legal codes and its use by governmental industrial hygiene units to prevent injury to workers.

Two important—and frequently conflicting—factors must be considered. If a large number of individuals are already at work in conditions which may be injurious, there is an urgency for criteria which will define a safe and healthful environment. On the other hand, if a standard is selected which is arbitrary and capricious, the obtaining of the voluntary compliance by a majority of the industrial units involved will be difficult, and enforcement practically impossible. It must be recognized, too, that "tentative" standards sometimes inadvertently have lost their qualifying description, and, by frequent and uncritical repetition have acquired a stature never implied by the initial proponent.

The present status of the noise problem presents many similarities to the relatively early periods in the evolution of other major industrial hygiene hazards. Following an initial recognition that an industrial physical or chemical agent might be associated with injury to workers, there occurs a variable period in which the relationship is subject to test and evaluation by other investigators. The levels of exposure which existed prior to the injury are determined, and, after these are reduced by an arbitrary factor of safety, the workmen exposed to the lower levels are the subject of continued clinical study to detect further injurious effects. This procedure is repeated until environmental conditions are established where no injury can be detected with very prolonged exposure. These latter values then become the basis for "standards" of safe working conditions—the "maximum allowable concentrations."

When an occupational illness results shortly after the introduction of a new agent, the causal relationship is frequently readily accepted. If, however, the agent is one which has been in use a long time, and the identification of its injurious action comes only after a gradual increase in exposure has resulted in harmful levels, there may be considerable resistance to recognizing the cause and effect status. Similarly, the more obscure the disease pattern, the more difficult its differential diagnosis from disease which occurs as a non-occupational entity, the slower its acceptance.

The problem of noise and its relation to hearing loss is complicated by both of these characteristics which deter a ready acceptance of the relationship. Excessive levels of noise, as judged by the more recent criteria, have occurred in certain industrial operations for many years. The limited number of published reports which conclude that hearing loss results from relatively high level noise exposures have not been convincing enough to create much concern. Although the diagnosis of deafness is not difficult, the differentiation between "occupational" hearing loss and that resulting from non-occupational causes is extremely difficult, if not impossible in many instances. The confusion engendered by the widely variant methods of evaluating hearing loss has further muddied the waters.

FROM discussions with many industrial physicians and industrial hygienists over the past few years, it is evident that their present attitude is one of concern and confusion, a recognition that the problem may become serious, but that the evidence thus far presented quantitatively relating noise to hearing loss lacks conviction except in the case of a few very high level exposures. More of the industrial physicians and hygienists are recognizing the complexity of the problem, the necessity of employing relatively complicated measuring techniques, and the great technical and economic difficulties in applying control procedures. There is general agreement that standards must be developed and broadly tested in controlled studies in actual industrial conditions, but there is no unanimity as to the "how" and the "when" and the "where."

In the control of hazardous conditions in in-

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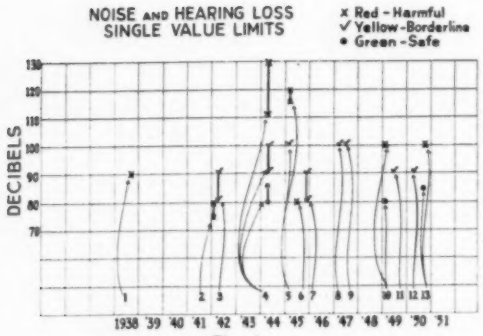


Fig. 1.
Single over-all levels from literature.

dustry, standards which define safe environmental factors play an increasingly important role. Industry relies in a constantly greater degree on such criteria, and many governmental regulatory units regard such standards, incorporated into official codes, as the most effective means of enforcing a healthful industrial environment. The majority of industrial and governmental health personnel would agree that for self-regulation by industry a tentative standard, based on admittedly incomplete data, may serve a useful purpose. However, there is a widely divergent attitude toward the use of such a tentative figure in a governmental code.

In searching the literature for information concerning standards for noise which would serve as a point of departure in an industrial control program, one is impressed with the considerable variability of values thus far suggested. It should be emphasized that, for this purpose, the effect of noise on hearing loss was the sole criterion. The data with respect to comfort and other psychological effects are too varied and indefinite to permit even a reasonably reliable interpretation.

The initial values suggested were single over-all measurements of noise. In the cumulation of references in review articles, the background and relative authority of a figure frequently is lost. In addition, the qualifying phrases and statements often lose their significance in abbreviation.

A representative sample of the single over-all noise values which have been published since 1938, indicating either harmful, borderline, or safe levels, is shown in Fig. 1. No attempt will be made to give the values a "weighting" as to their reliability, but a brief quotation from the original articles will help to establish the significance which the respective authors intended. The numbers at the bottom of the arrows indicate the references given below, in order:

1. McCORD: "Experience indicates that a noise level of 90 decibels or higher is definitely harmful to the human ear."[1]

2. ROSENBLITH: "It is difficult (to state) the minimum noise level that would be harmful. It appears that as little as 75 or 80 decibels if sufficiently prolonged, suffice to bring about a premature aging of the ear."[2]

3. BUNCH: "The boundary line between noises which cause hearing losses and those which do not lies between 80 and 90 decibels."[3]

4. McCOY: "It is probably true that a noise level of 80 to 85 decibels will cause some defects of hearing in the high frequency zones after a period of years."[4]

5. DAVIS: "We do not have rigid proof of permanent impairment of hearing by noises of less than 115 or 120 db .... and concern about exposure to noise levels below 100 db .... is probably unwarranted."[5]

6. GOLDNER: "A consensus seems to indicate that the minimum safe level is in the neighborhood of 80 decibels, and that an exposure of at least two years is necessary to produce changes at this level."[6]

7. SCHWEISHEIMER: "The boundary line between noises which cause hearing losses and those which do not seems to lie between 80 and 90 decibels."[7]

8. MacLAREN and CHANEY: "The borderline between relatively harmless noise and that which produces steady deterioration lies in the region of 100 db."[8]

9. FOWLER: "Noise of less than 100 decibels may reasonably be considered quite safe, except perhaps for a few unusually susceptible individuals."[9]

10. CANFIELD: "The consensus is that noise levels not exceeding 80 db above the normal human threshold cannot be harmful to the human ear. . . . Exposure of human beings for periods of weeks to noise levels above 100 or 110 db will definitely result (in damage)."[10]

11. GROVE: "For its effect on the hearing function one can, however, safely disregard noise of less than a 90 decibel level . . ."[11]

12. GUILD: "The guess that is usually made .... is that the upper limit of safety, for factory conditions, is probably about 90 decibels above the threshold of hearing."[12]

13. KRYTER: "A fair, perhaps conservative, evaluation....would seem to be that for long and intermittent exposures any frequency of sound (or narrow band not exceeding the critical width) that is 85 db or less above 0.0002 dyne/cm$^2$ will not cause any temporary or permanent deafness...." "For brief exposures....the intensities necessary to cause deafness appear to be in the order of 100 db re 0.0002 dyne/cm$^2$ for any frequency or critical band."[13]

THE limitations of the single over-all level are increasingly emphasized in the past few years, and standards defined in terms of frequency and intensity recently have appeared.[13,14,15,16] In addition, means for comparing noises of different spectral composition, intensity, and duration by converting them to an "equivalent acoustical injury index" have been proposed.[14] The factor of individual susceptibility

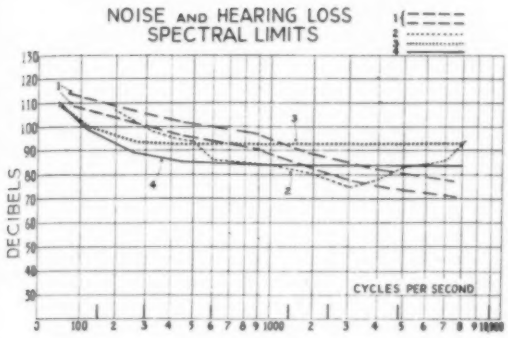


Fig. 2.
Frequency-intensity limits from the literature.

is considered, and an estimate is included as to the percent of the population which would be involved in the limits.[15]

Four of such frequency-dependent "standards" are shown in Fig. 2. The arrow numbers indicate the corresponding references below:

1. MCGRATH: The frequency-intensity range values represent the limit of safety for noise which is "centred" in the respective octaves. In addition, a method is proposed for converting noises of different spectral composition, intensity, and duration into an "equivalent acoustical injury index" in order to compare them. Provision is made for weighting variant and intermittent factors. The assumption is made that "the harmful effect of noise varies directly with both the intensity (expressed in dynes/cm$^2$) and with the frequency . . ."[14]

2. KRYTER: The curve is constructed by using critical band measures of noise intensity and plotting such measures relative to 85 db above the minimum audible threshold for pure tones (not the average threshold for the population which is about 15 db above the minimum audible pressure). The author stipulates that the resulting curve is "a prediction, undemonstrable with present data."[33]

3. BOLT, BERANEK, and NEWMAN: This curve has been designated "damage risk criteria," with the authors estimating "about 95% of the population run a negligible risk of damage if exposed to levels everywhere lower than the octave band values given."[15]

4. BERANEK: This curve is for "levels (of pure tones) not to be exceeded to assure no permanent damage to hearing." It imposes a more rigid qualification than the standard proposed by this same author for continuous spectrum noises (which, though not shown in this graph as such, would coincide with No. 3).[16]

ALTHOUGH the criteria upon which these curves depend are not exactly comparable, they represent levels which are suitable for test in actual industrial conditions. The spread between the high and low values (which, incidentally, are reversed for several of these curves in the lower and upper ends of the spectrum) is considerable excepting at the lowest octave band. These differences might be very great from an economic and technical viewpoint in the matter of providing environmental controls. It must be emphasized that their major value at present is as tentative standards which industry can now test against the background of the wide variation of noise patterns encountered in industrial operations.

Although considerable advance has been made in the matter of proposed standards, the values given thus far represent the judgment of a single or small group of investigators. It is true that frequently they are the individuals with the greatest experience and closest identity with the problem, and have made substantial contributions to its solution. Nevertheless, in practice, the standard which results in effective action by industry is usually developed only after it has been tested in a wide variety of actual work conditions. This standard is, then, a synthesis, sometimes with the element of practical compromise, derived from the multiple judgments of individuals with diverse viewpoints and interests. In general, the broader the segment of industry to which the standard applies, the less the "weighting" of the strictly technical component in the final standard achieved.

THAT interest in the subject of industrial noise has been intensified in the past few years is attested to by the attendance at the recent meetings and symposia. A number of industrial organizations have begun or accelerated studies on this problem. It seemed worth-while to obtain a cross section of the current opinions and attitudes toward standards of noise from individuals who ultimately would play an important part in establishing reliable and acceptable criteria for industrial noise.

Questionnaires were mailed to 275 individuals and replies received from 222, a response which far surpassed the author's expectations. The selection of individuals admittedly was arbitrary, but included a number from each of several fields which have a direct interest in the problem: acoustical engineers, physicists, phychologists, otolaryngologists, industrial physicians, and industrial hygienists. An attempt was made to secure a reasonable distribution as to type of employment—whether by industry, government, educational institution, and private or consulting practice.

A series of questions was included by which it was hoped to identify the relative activity of the respondent in studies relating noise to hearing. A classification of the replies was made in the following manner, and the number in each class is given:

1. Those who, for one reason or another, did not give sufficient information to permit its inclusion in the study .....32

2. Those who have not had direct contact with

DISTRIBUTION OF OPINIONS AS TO ADEQUACY OF PRESENT INFORMATION IN RELATION TO STANDARDS OF NOISE FOR INDUSTRIAL AND GOVERNMENTAL PURPOSES

TABLE I.
BY PROFESSIONAL CATEGORIES

| | | Oto-laryngol-ogists | Engi-neers | Physi-cists | Indus-trial Hygien-ists | Indus-trial Physi-cians | Others |
|---|---|---|---|---|---|---|---|
| TO BE USED SOLELY BY INDUSTRY AS A GUIDE TO CONTROL NOISE CONDITIONS | a. present information inadequate | 2 | 4 | 3 | 11 | 6 | 1 |
| | b. sufficient information to establish tentative standards | 8 | 15 | 13 | 16 | 19 | 15 |
| | c. standards can be established now with fidelity | 1 | 1 | — | 1 | 1 | — |
| TO BE ADOPTED IN GOVERNMENTAL REGULATORY CODES | a. present information inadequate | 3 | 8 | 10 | 14 | 13 | 10 |
| | b. sufficient information to establish tentative standards | 4 | 3 | 2 | 3 | 4 | 3 |
| | c. standards can be established now with fidelity | 1 | — | — | — | — | — |

TABLE II.
BY EMPLOYING AGENCY

| | | Industry | | Government | | Education and Consulting | |
|---|---|---|---|---|---|---|---|
| | | No. | % | No. | % | No. | % |
| TO BE USED SOLELY BY INDUSTRY AS A GUIDE TO CONTROL NOISE CONDITIONS | a. present information inadequate | 17 | 44% | 1 | 3% | 6 | 18% |
| | b. sufficient information to establish tentative standards | 21 | 54% | 29 | 94% | 26 | 76% |
| | c. standards can be established now with fidelity | 1 | 2% | 1 | 3% | 2 | 6% |
| TO BE ADOPTED IN GOVERNMENTAL REGULATORY CODES | a. present information inadequate | 19 | 87% | 15 | 65% | 17 | 68% |
| | b. sufficient information to establish tentative standards | 3 | 13% | 8 | 35% | 7 | 28% |
| | c. standards can be established now with fidelity | — | — | — | — | 1 | 4% |

investigations in this field and have not "closely followed the literature" .....22

3. Those who have no direct investigative experience, but have "closely followed the literature" .....46

4. Those who have participated in "studies relating noise to hearing" .....122

The substance of the questionnaire was a series of questions asking the opinion as to:

1. The status of present information relating to the establishing of standards to be used by industry and by governmental regulatory bodies.

2. The single over-all intensity value which is "safe" for continuous exposure.

3. The single over-all intensity value above which, even for brief, repeated exposures, there is a probability of permanent deafening effect.

4. A frequency-intensity curve which gives the maximum "safe" values for continuous or near continuous working-day exposure.

An appreciable number of individuals in Class 4, i.e., "those who have participated in studies relating noise to hearing," answered all four questions, but answers were used in the summary even though all the questions were not completed. The subsequent analysis will deal almost solely with this group.

Many qualified their answers—particularly to the questions on single over-all levels. A number expressed apprehension that standards would be established prematurely. Perhaps the high percentage of comments offered is the best index of the great interest among all polled.

In reply to the question concerning the attitude toward the present status of information and its use as standards, a large majority of all professional groups (73%) indicated that there were sufficient data to establish tentative standards to be used solely by industry as a guide to control noise conditions. An equally large majority stated that the information was inadequate so far as incorporation in governmental regulatory codes was concerned. The distribution of the replies by professional group is shown in Table I. It is obvious from an inspection of the figures that there is general agreement by all professional categories that there is now sufficient information to *guide* industry in a real attack on the noise problem, and with about the same degree of conclusion, that the information *is not adequate* for use by governmental regulatory agencies in codes governing noise levels. The classification of answers by employer—industry, government, or educational institution and consulting practice—is shown in Table II. While the majority of all groups again feel that there is sufficient information to *guide* industry in the matter of noise standards, it is interesting to note the variation in emphasis. The high percentage (94%) of replies by governmental employees suggests that they will not be satisfied unless industry does make an active attack upon the problem. Again, with respect to the use for governmental regulatory codes, 65% of the governmental group replied that present information was inadequate.

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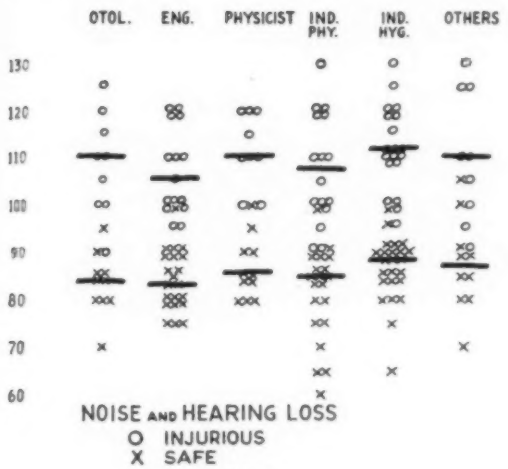


Fig. 3.
Estimates of "safe" and "harmful" single over-all levels, by professional classifications.

The replies to the two questions on single over-all values for "safe" and "harmful" levels of noise, distributed by professional classification, are presented in Fig. 3. The spread of values is rather dramatic and expressive. The median values, indicated by the lower and upper bars respectively for "safe" and "harmful" levels, are in remarkable agreement for the different occupational categories, at 85 and 110 decibels. When a similar breakdown is made by the employing agency (Fig. 4) the median values are in good agreement except for the slightly more conservative estimate of the "harmful" threshold at 100 db by the individuals in educational institutions and consulting practice.

Although not shown in these graphs, the values for Class 3 respondents—those who have followed the literature but have not participated in studies—form a distribution pattern which is almost identical to most of these Class 4 groups, with median values again at 85 and 110 db.

The presentation of the answers to the final question, that of a maximum "safe" intensity-frequency curve, is best done graphically. Many respondents qualified their replies by indicating that they were "guesses" or "estimates." A number pointed out that this question might have been better phrased by defining the points on an octave band scale, or at least by qualifying the width of the bands at the reference points. While admitting the merit of these suggestions, the author is doubtful that the actual results shown here would have been greatly modified. Nevertheless, the variability that occurred was somewhat greater than expected—and is shown in Fig. 5. One is scarcely justified in attempting an analysis under these circumstances, but the median values might be indicated. They begin at 100 db at 100 cps and descend quite regularly to 90 db at 1,000 cps. There is a further downward progression to 85 db at 5,000

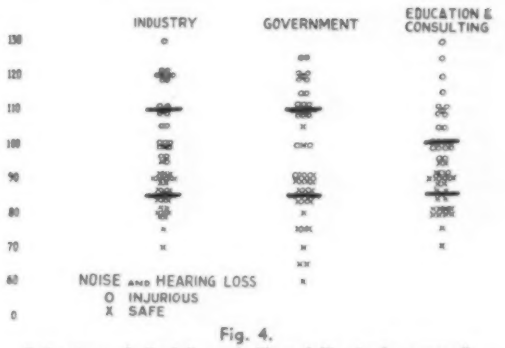


Fig. 4.
Estimates of "safe" and "harmful" single over-all levels, by employment background.

and 6,000 cps, with a rise to 90 db at 10,000 cps. The wide scatter of estimates suggests the improbability of obtaining a reasonable agreement on such a standard without a great deal more information.

## Discussion

DESPITE the obvious limitations of the questionnaire method, and, perhaps, the design of the specific questions submitted, the results presented above offer, in the opinion of the author, a good indication of the current attitudes and opinions concerning the establishing of standards for industrial noise in relation to hearing loss. The population polled is representative of an important and influential group so far as establishing standards and obtaining their substantial acceptance by industry.

Although the median values for the "safe" and "harmful" single over-all levels of noise are in good agreement so far as the various professional and type of employment classifications, the scatter of individual values is so great as to prevent, in all probability, the present acceptance of any fixed value by a sufficient majority. The situation with respect to a limit defined in terms of intensity and frequency is no better. In spite of this, a considerable majority of all classifications expressed the opinion that there was sufficient information to establish tentative stand-

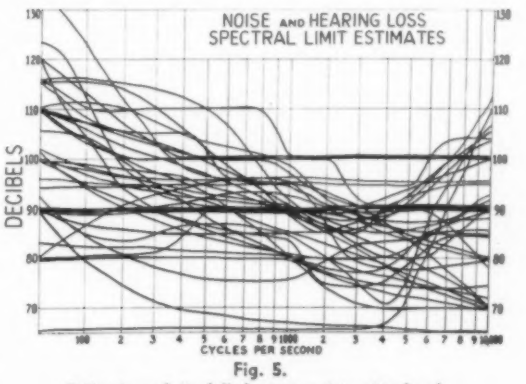


Fig. 5.
Estimates of "safe" frequency-intensity levels.

ards for industry, for the purpose of guiding control measures. The apparent contradiction suggests that at present the "guiding" will be limited to further study at the intermediate noise levels (85 to 110 db), and that serious control procedures requiring a considerable expenditure of effort and money will be recommended with any deep conviction only for levels above 110 db.

The lack of agreement among the individuals who have suggested, in past publications, single over-all noise level standards is continued in the present opinions of the individuals who have participated in noise studies. There is also considerable variation in the recently published intensity-frequency standards. Obviously, much more information is required to establish the standards with the degree of reliability that will make them acceptable—and effective—throughout industry. The stage has been reached where the proposed standards must be tested in a variety of actual plant conditions. If industry wants a standard which it can accept, it must provide the opportunity, investigative personnel, and subjects essential to a better evaluation.

IT IS RECOGNIZED that the publication of a few well-controlled and comprehensive studies relating noise to hearing loss might greatly modify the present wide distribution of opinion concerning safe and harmful levels. Certainly the evidence is not presently available, as reflected in the above opinions, to justify immediate and drastic recommendations to management by industrial health personnel for the control of commonly encountered noise levels in the range of 85 to 100 db. The more recently developed intensity-frequency standards must command the serious attention and respect of industrial physicians and industrial hygienists, but the discrepancies among the proposed limits suggests the lack of significant supporting data at this time. If such information has been developed, some way must be found to make it available for study by the interested parties. Although a majority of the respondents agree that the present information is inadequate for use in governmental regulatory codes, a number of individuals in positions of responsibility in governmental industrial hygiene organizations emphasize the need for such official criteria. The difficulty in arriving at a reasonable value, as judged from the above data, is obvious. The outside single over-all limits of "safe" and "harmful" have median values of 85 and 110 db, but note that 50% of those replying consider these values respectively to be too high and too low. It is quite generally agreed that without an acceptance of the standard by a substantial part of industry, a code value would have little significance and slight chance of enforcement.

An attitude and opinion inventory such as this may serve several useful purposes. It is obvious from the wide scatter of values submitted that either the basic data relating noise to hearing loss, excepting at very high levels, fail to carry conviction or that such information, if adequate, has not been sufficiently disseminated. A corollary interpretation is that without a substantially greater agreement among industrial health personnel there is little chance of obtaining a broad acceptance of standards by industry—with the consequent effective action needed to provide adequate control measures. The majority attitude expressed, that present information is not sufficient to permit incorporation of standards for noise in governmental industrial hygiene codes, concurred with to an equal degree by individuals from government, private practice, and industry, should reassure those who are apprehensive about this point.

One conclusion—and perhaps the most important one to be drawn from this material—is that we now have the opportunity, through testing the proposed standards in a wide variety of field conditions, to develop criteria for a safe and healthful auditory environment which can be accepted by the majority required to make such standards effective. As has been emphasized, standards are not an end in themselves, but they are essential to an intelligent, coordinated solution of a problem such as industrial noise.

[NOTE: The author wishes to take this opportunity to express his great appreciation to the many interested individuals in this field who replied to the questionnaire in spite of their misgivings about the construction of the questions and their apprehension as to the final purposes and values from such an approach. The very high percentage of replies attests the deep interest in this serious problem.]

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# Industrial Loss of Hearing: Medical Aspects

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IN MAY, 1947, a representative of the Liberty Mutual Insurance Company asked me to serve as consulting otologist for his company in the matter of industrial deafness as it presented itself at Despatch Shops Incorporated, a subsidiary of the New York Central Railroad, and the only concern of its kind making steel freight cars in the State of New York. The representative asserted that within one department of the shop alone, the so-called steel plant, some 300 to 400 men had hearing losses, and that all these employees represented real or potential compensation claims. Two months later the attorney for the labor union offered me the same job as consultant for the union. Two and one-half million dollars, he declared, was the compensation stake involved. For a period of three years I was the sole otolgist for both parties, who seemed confident that my findings and interpretations would be impartial. In litigation proceedings the union representative and I sat beside each other, with a battery of lawyers on the opposite side of the table.

## Industrial Deafness—Problems and Complications

1. TO ALL intents and purposes the insurance representative spoke advisedly when he set forth the extent of this problem, for, of the men employed in the steel plant for five years or more, apparently all do have industrial deafness, and all do represent real or potential compensation claims which at the present time are estimated at the figure of 730.

2. Under the labor laws of the State of New York, compensation awards have previously been made only if an injury was disabling or caused the employee loss of time from work.

3. Since industrial deafness is not disabling and does not cause the employee loss of time from work, by statutory enactment at least, occupational deafness was not considered a compensable disability. In spite of this fact, however, four or five years ago three compensation awards for industrial deafness were made in Buffalo, New York, and a Supreme Court appeal of these decisions was overruled.

4. Since this decree altered the entire concept of compensation coverage, the insurance carriers have accepted the validity of industrial deafness as an occupational disease and therefore as a compensable matter.

## In the Manufacture of Steel Freight Cars

TYPE OF CLAIMANT: The men working in the steel plant at East Rochester, New York, are wholesome, substantial, and industrious persons who are interested primarily in their jobs which pay them from $85.00 to $100.00 per week, and only secondarily are they interested in their deafness or in the compensation that might be derived therefrom. For the most part, the employees accept deafness as part of their work, and, paradoxically enough, appear to get along better and be more contented after they have acquired a certain amount of hearing loss.

NOISE LEVEL AND LENGTH OF SERVICE: The over-all noise level in the steel plant is approximately (and continuously) 115 to 120 decibels, and 90% of the men so far examined have worked in this atmosphere of noise from 10 to 30 years.

DURATION OF THE LEGAL PHASE: The first claim for compensation for industrial deafness at Despatch Shops Incorporated was made in 1946.

ATTITUDES OF THE LABOR LEADERS, THE WORKERS, AND THE MANAGEMENT TOWARD EACH OTHER: The manager of the company came up from the ranks. He can do any job in the shop as well as (or better than) the regular workers, and he has been a supervisor in nearly every department. The men idolize him and call him by his first name. He wants the employees compensated for their disabilities but he knows that if compensation awards have to be paid as rapidly as claims might be presented, the plant will be closed and that the workers will be thrown out of their jobs. The union leaders understand this situation and take a realistic attitude toward it.

TYPE AND DEGREE OF DEAFNESS: Every claimant I have examined has shown a nerve deafness in both ears, and no claims, so far, have been made by any employees who have worked less than five years in a noise level of 115 to 120 db.

The hearing losses are usually about the same in both ears, but when one ear is more affected than the other (right or wrong) the asymmetry is explained by the position of the employee with respect to the source of the noise. The approximate percentage losses for speech by the Fletcher 0.8 method vary in degree from 20% to 90% in each ear. I have never seen a case of total deafness—even in one ear—occur as a result of occupational deafness as it is observed in the manufacture of steel freight cars.*

## Methods of Studying the Claimants

LEVELS OF HEARING—PLATEAUS: Although the present subject matter does not lend itself to a recital of the technique of taking histories, making examinations, sending reports, and sub-

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*Occupational deafness must be differentiated from traumatic deafness which is not an occupational disease.

mitting opinions; suffice it to say that the patient undergoes a complete acoustical study, and audiograms, made after the employee has had at least five years' exposure to loud noises, show certain levels of hearing which we have designated as plateaus. Six months to 18 months following an original examination new audiograms establish new plateaus. By comparing these plateaus we can determine whether the hearing losses have increased, or decreased, or remained the same.

If the respective plateaus on repeated examinations are at the same approximate level, we conclude that during the period under observation—and only during the period of observation—the claimant's hearing losses remained the same. If, however, comparative audiometric plateaus are at different levels, then the claimant's hearing losses have increased or decreased and, obviously, his occupational deafness for that particular period must be considered as lacking in degree of permanency. It is interesting to note that industrial deafness as it presents itself at Despatch Shops Incorporated does not necessarily increase or decrease in a gradual or uniform matter, but may progress or regress in a rather abrupt or precipitous way with intervals as long as three years in which plateaus may remain constant. Occasionally, and for no apparent reason, the hearing gets better and the plateau rises even when the employee has continued to work in a noise level of 115 to 120 db.

NERVE FATIGUE AND NERVE DEGENERATION: Certain patients were examined on Friday (the last working day of the week) and then again on Monday (after two days' rest from the steel plant). Seventy-five percent of these employees showed improved hearing on Monday as manifested either by a rise in the audiometric plateau, or by an increased ability to carry on a two-way conversation in spoken and whispered voice. Obviously such a degree of improvement represents a fatigue factor and should not be confused with the basic deafness which is probably the result of actual acoustic nerve damage or degeneration.

After nearly five years in observing occupational deafness as it occurs in heavy industry, it appears that in approximately 60% of employees permanently removed from many years exposure to a noise level of 115 to 120 db, an appreciable degree of improvement in hearing was observed in some employees for a period of six months; in others for a period of 12 months and in two individuals for a period of 18 months. Statements to the effect that complete recovery ends in 48 hours or 30 days or three months were not borne out by my experience.

Too often casual observers interpret the initial and greater recovery which comes within the first two or three weeks after removal from exposure as the total fatigue factor; more experienced observers, however, believe that gains of 15% to 20% may be evident six months to 18 months after removal from exposure.

## Changing Plateaus and Compensation

SINCE final settlements for compensable claims are based on the permanency of the injury, and since audiometric plateaus—even after long periods of apparent fixation—have shifted up and down, the insurance carriers have taken the attitude that no claim should be paid until the degree of permanency is established.

The claims of 40 men, all of whom I examined on two to four occasions over a period of three and a half years, are now held in obeyance pending a decision of the Compensation Commission in regard to the permanency of their deafness.

It is interesting to note that in Rochester, New York, 18 cases have been closed without prejudice to the claimant's right to reopen them whenever there is evidence to justify re-applying; in these cases no award was made since there was no lost time and no medical proof of permanency.

In one two-day session three years ago I testified in 18 cases. Ten claims were deferred or settled for reasons of expediency, and eight claims developed into test cases for determining the method of handling the remainder of the 730 real or potential compensation actions. In all eight cases the referee made awards based upon hearing losses represented by the audiometric plateaus on my last examinations. On the question of permanency, however, the carrier took exception to these awards and appealed the decisions. The Compensation Board, caught in the dilemma of wanting to sustain the referee's awards on the one hand, and not subjecting itself to justifiable criticism on the other hand, appointed an impartial otologist, the idea being to check technical errors or faulty reasoning, or to find the attorneys incorrect in some of their legal and medical assumptions.

Fortunately, the impartial otologist verified our audiograms, substantiated our comments, concurred in all of our opinions, and subscribed to all of our theories concerning the development of industrial deafness as it was advanced in the testimony.

The Board therefore reversed the referee's decisions in the eight cases in which awards were made, and referred them back to the local district for rehearing.

## An Attempt to Conduct a Scientific Study

JUST as a respite from the legal tangle we have been presenting, I shall offer briefly a summation of the attempts of the Sub-Committee on Noise in Industry of the American Academy of Ophthalmology and Otolaryngology to conduct a purely scientific, non-controversial study of industrial deafness as it occurs in the manufacture of steel freight cars.

1. Obviously, pre-employment examinations and examinations during employment are necessary in any comprehensive study of the development of industrial deafness. It is true that both management and union leaders paid lip service

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to the value of such studies but in my opinion both of these factions frowned upon such research. In any case I did not sell the idea either to the management or to the labor leaders.

2. One of the first assignments for Dr. Douglas Wheeler, the acoustical engineer and purely scientific investigator for the Sub-Committee on Noise in Industry (of which I am a member), was to spend several weeks at Despatch Shops Incorporated in an effort to discover, if possible, what produces industrial deafness. The committee wished to get the answer to several questions, for example: Is the cause of industrial deafness the intensity, or the volume or the amplification of sound? Is the cause of industrial deafness a pulsation of sound waves? Is the cause of industrial deafness the ricocheting of vibrations within a confined space? Is the cause of deafness a secondary vibration of surrounding structures or what factors do produce it? Truly, these are non-legal and non-polemical problems.

3. Although the piling up of claims for industrial deafness has compelled the management to consider substituting a welding process for the regulation riveting and drop-hammer method of constructing steel freight cars, the reducing of the life expectancy of a freight car from 11 years to four and a half years along with other questions concerning its stability have discouraged efforts in this direction. This matter was considered from the practical rather than the scientific approach to industrial deafness.

## Compensation Problems

WHAT IS THE RELATIONSHIP OF THIS WHOLE PROBLEM OF INDUSTRIAL DEAFNESS (a) TO THE INDUSTRY, (b) TO THE WORKER, and (c) TO THE COMPENSATION COMMISSION?

(a) *What is the Relationship of this Whole Problem of Industrial Deafness to Industry?*

With genuine sincerity the management has said that if 730 claims for industrial deafness are awarded as they come up for hearing, the plant, which is not a large one, will have to close, for it cannot compete with concerns that have no problem of industrial deafness.

Perhaps I should explain that the importance of Despatch Shops Incorporated in the problem of industrial deafness lies not in the size of the plant nor in the number of men employed, but rather in its pioneering of compensation claims emanating from such a cause. This relatively small plant was the spearhead of a nation-wide movement to establish industrial deafness as a compensable matter.

One should note that approximately 53% of the average plant employment for 1951 (that is 730 potential claims out of the 1951 average employment total of 1520) has some degree of occupational deafness. On February 1, 1952 the actual figure was 54%. If one assumes that what is true for a small plant in heavy industry, may also be true for a large plant in heavy industry, then a similar rate (let us say somewhere about 53%) represents the total potential claims in any plant that has the same working conditions as the East Rochester factory.

In spite of the general admission that loud noise is a common denominator in all heavy industries, the fact remains that compensation claims for occupational deafness have appeared only sporadically throughout this country. Those of us who have watched the matter closely have observed many plants in heavy industry and also many states in which (so far) no claims have been made for disabilities resulting from prolonged exposure to loud noise, a situation which has tempted certain companies to close a factory and move it to another locality where the immediate problem of industrial noise will be less acute.

(b) *What is the Relationship of this Whole Problem of Industrial Deafness to the Worker?*

The price the workers may have to pay for immediate compensation awards for industrial deafness, in the smaller plants at least, could be the permanent loss of good jobs at which many of them have worked for more than a quarter of a century and at exceedingly good wages.

(c) *What is the Relationship of this Whole Problem of Industrial Deafness to the Compensation Board?*

Apparently the Compensation Commission of the State of New York understands the serious implications of the problem of industrial deafness and is, I believe, considering the following compromise as a means of satisfying all parties concerned and of keeping industry going and the workers employed.

1. No award shall be made until some period—say six months to 18 months—after the claimant is retired or for other reasons permanently leaves the employment of the company.

2. At that designated time the audiometric plateaus obtained will be considered as levels representing permanent hearing losses, i.e., provided the claimant shows no evidence of simulating or exaggerating his deafness and providing some rectification factor can be used to appraise the non-traumatic element of deafness resulting from advancing age.

3. Cash payments will be made promptly when the foregoing conditions are fulfilled.

This compromise offers the following advantages:

1. The industrial plants will be kept in operation.

2. The worker will have continuous employment and will not (in an effort to obtain similar work) be required to remove himself and his family to another locality.

3. Deferring payment of awards until retirement will spread an otherwise ruinous expenditure over a period of years and lighten an almost unbearable financial burden on the employer and carrier.

4. The worker will get his award on retirement when he needs it most.

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# Medical Care in a Surface Transportation Company

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THE high incidence of bus accidents reported each year by the National Safety Council is well known.[1] This danger to public safety as manifested by the great number of persons killed and injured can be greatly reduced by proper medical supervision of employees in the transit industry.

The Medical Department of the Third Avenue Transit System was reorganized in 1947. The new Medical Department instituted a program of extended medical service in an effort to improve the health of the employees, and reduce the accident rate. The first part of this program, proper pre-employment medical examinations, was reported in a previous communication.[2] It was shown that with the institution of high standards for the selection of bus operators the accident rate was reduced 44% in our company.

This communication will report on other facets of the extended medical service program, such as improved medical facilities, methods of study of illnesses and accidents, and periodic medical examinations and the results obtained thereby.

## Clinic Facilities

THE Third Avenue Transit System maintains a medical clinic which remains open all day. The morning clinic has in daily attendance one general practitioner and two specialists in internal medicine. Three specialists in surgery attend the afternoon clinic on alternate days. A registered nurse is on duty throughout the day. A laboratory technician and three secretaries comprise the remainder of the regular personnel. Specialists are available for consultation in all branches of medicine. Our staff is supplemented by six physicians who make home visits to patients absent from work over five days. These physicians are also available for service in the clinic whenever needed. When large numbers of routine physical examinations are to be done, our regular staff is augmented from this group.

The clinic is available to the patients' own private physicians for any consultation service or laboratory work. Information is submitted directly to the patient's doctor.

All garages are equipped with first aid kits as specified by the Public Service Commission. Emergency care is afforded the employees at these garages until medical care can be obtained. Every garage has a group of physicians on call for emergencies.

## Study of Medical Absences

A DETAILED study of every medical absence assures the employee of proper medical care and helps reduce absenteeism and the accident rate.

1. When an employee comes to the clinic for any illness or accident, his chart is studied by the physician to determine the nature of any previous pathology. At the same time, a complete history is taken, a physical examination is made, and all necessary laboratory data are obtained.

2. Any operator who is away from work five days or more is visited at his home by a staff physician to determine the reason for his absence. If he does not have his own physician, our staff physician will prescribe for him if he wishes. If the employee has his own physician we request a complete report from him.

3. In New York State, since July 1, 1950, a Disability Benefit Law has been in effect. Disability forms must be filled out by the attending physician. These reports augment the knowledge of the patient's physical status.

The above methods of observation permit meticulous study of each sick employee. If a patient is permanently unable to work as a bus operator because of a physical defect or illness, he is either pensioned or another job is found for him that will not aggravate his condition or be dangerous to public safety. An example of such a case follows:

The patient, J.P., a 48 year old male, had an episode of syncope while in bed on June 29, 1950. He was taken to a city hospital where the summary stated:

"Patient admitted after a convulsive seizure; no neurological history, signs, or symptoms. Blood pressure 115/75 on admission; 186/110 on following day. Patient asymptomatic. Signs out."

The operator came to our medical clinic with a certificate from his private physician stating that he was able to return to his regular job. Our staff felt that the episode required complete investigation. The possibility that this patient had had a convulsive seizure was sufficient to make his driving a bus a hazard to public safety. We referred him for a complete neurological study to the Veterans' Administration Hospital where physical examination revealed the following: Blood pressure 180/120; normal fundoscopic examination except for Grade II sclerosis.

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Otherwise the physical findings were normal. All laboratory data were normal except for an electroencephalogram which was consistent with a diffuse encephalopathy. A diagnosis of cerebral arteriosclerosis with cerebral dysrhythmia was made.

In view of these findings, the Medical Department refused to permit the patient to drive a public vehicle, and he was given a job in the Stores Department. He was loath to accept the decision of this clinic and requested re-examination. He was re-admitted to the Veterans' Administration Hospital in October, 1950, for repeat study. This disclosed the same electroencephalographic findings.

Since the original episode in June had been the only one sustained by the patient, he decided to see another neurologist. The findings were corroborated by this consultant, who agreed that the patient should not be permitted to drive a public vehicle. With this conclusive evidence, the operator accepted his transfer and expressed his gratitude to the Medical Department for placing him in a position which was without danger to the public or himself. A year later he had another convulsive seizure, at work. It is obvious that had this occurred while he was driving a bus, a serious accident involving the public might have resulted.

## Study of Accidents

THE Medical and Safety Departments cooperate in the study of accidents. Regular group safety discussions with films are routine for all drivers. Safety literature is posted on all bulletin boards, and drivers are constantly checked by instructors. Driving awards have proved an excellent incentive to the maintenance of a high safety record. The Safety Department studies the details of each accident, and meets with the union representatives and the operators to determine whether it could have been prevented.

The operator of a vehicle involved in a major accident, or in repeated minor accidents, is tested on the psycho-physical testing apparatus and is then referred to the Medical Department. Complete medical examinations are done. In addition, the staff physician studies the operator's history, his social life, home environment, illnesses, and domestic problems to determine any reason for anxiety. Attempts are made to correct any defects. The following case demonstrates the importance of medical study of an accident repeater.

C.G., a 28 year old male, was referred to the Medical Department by the Safety Department because of three accidents within two months. His past accident record had been excellent. Physically, he was within normal limits. During the medical interview it was discovered that he had been married recently. His wife was a Californian and was anxious to return to her home state. The operator feared that he would not be able to obtain a position and support his wife there. This led to constant bickering between the newlyweds, with an unsatisfactory home life. On the advice of the Medical Department, the operator took a leave of absence so that he could go to California. He returned with the information that his wife preferred New York to the West Coast and that the difficulties between them were over. He has been driving a bus for the past two years and has had no further accidents.

## Periodic Examination of All Operators

FROM 1947 to 1949 there was a change-over from trolley to bus operation, and all employees desiring transfer to bus operation were submitted to comprehensive medical examinations. In addition, all operators are required to have periodic examinations.

## Results

FIG. 1 shows the number of reported accidents under operator control in the Third Avenue Transit System from 1946 through 1950. Not all of these were preventable.

Table I sudivides the accidents in Fig. 1 into various categories. Vehicle collisions, the largest single type, were reduced from 5,270 in 1946 to 2,867 in 1950.

The number of passengers thrown from bus or trolley remained approximately the same from 1946 to 1950. However, there was a decrease in the number of pedestrians struck by trolley or bus from 386 in 1946 to 131 in 1950. There was also a decrease in intra-company collisions from 91 in 1946 to 27 in 1950. There was a decrease in the assaults from 49 in 1946 to 28 in 1950.

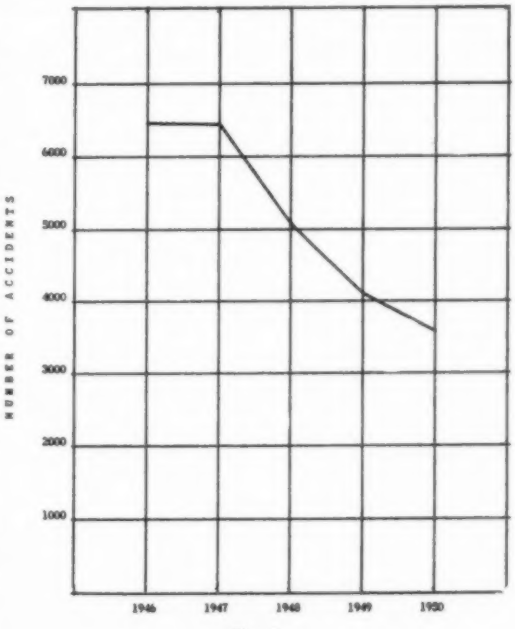


Fig. 1.

TABLE I.
ACCIDENTS OVER WHICH OPERATORS HAVE CONTROL

| | 1946 | 1947 | 1948 | 1949 | 1950 |
|---|---|---|---|---|---|
| Vehicle collision | 5,270 | 5,244 | 4,088 | 3,211 | 2,867 |
| Thrown from car or bus | 581 | 688 | 607 | 691 | 555 |
| Struck by car or bus | 386 | 273 | 247 | 186 | 131 |
| Intra-company collisions | 91 | 103 | 62 | 54 | 27 |
| Assault | 49 | 35 | 49 | 53 | 28 |
| | 6,377 | 6,343 | 5,053 | 4,195 | 3,608 |

We feel that physically- and mentally-healthy operators can avoid altercations.

There was a total decrease in accidents from 6,377 in 1946 to 3,608 in 1950.

In an effort to be critical of our results we compared them with those of similar major transit companies throughout the United States. We obtained data from the American Transit Association concerning six comparable companies, all of whom reported their accidents according to standard procedures set up by the American Transit Association.[3] In Fig. 2 the dotted line represents the average accident rate of the six companies. The solid line represents the accident rate in our company.

In 1947 when the Medical Department was reorganized, the high accident rate was one of its major problems. The rate was 14.55 per 100,000 miles of operation, as compared with 9.10 per 100,000 miles, the average of the six other companies. Within two years after the reorganization of the Medical Department, our figure had fallen to 10.50 per 100,000 miles, a decrease of 27.5%. These figures require explanation. On the one hand, it would be quite unfair to compare the company's statistics for this period with those of the other companies, because, admittedly, the field for improvement was so much greater in our own case. On the other hand, this achievement was accomplished during the period when the company was completing its change-over from trolley car to motor bus operation. All of the attendant problems of conversion, including retraining of operators, confronted the new Medical and Safety Departments.

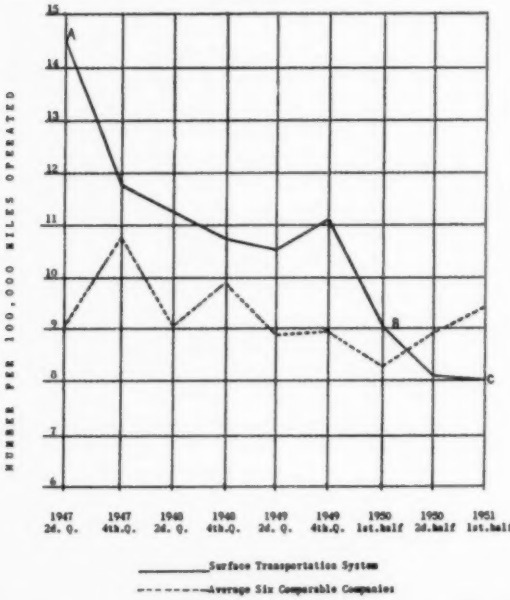


Fig. 2.

During the period from 1949 through the first half of 1951 the company reduced its accident rate still further to 8.02 per 100,000 miles of operation. In comparing our statistics with those of the other companies, it will be noted (Fig. 2) that, during the first half of 1950, the company's accidents dropped with respect to both absolute number and velocity. Continuing from the point of intersection "B" it may be seen that the accident rate for the six comparable companies increased for the first six months of 1951, while with our company the reverse occurred. During the four years of this improved medical-safety program our traffic accidents for motor buses dropped from 14.55 to 8.02 per 100,000 miles of operation.

The results of studying accident repeaters, submitting them to proper medical examination, and retraining them can be shown in the following figures. In 1948 there were 211 (of approximately 2,000) operators who were habitual accident repeaters, (three preventable accidents in a six-month period); 55 of the 211 were sent to the Medical Department for study and treatment, and to the Safety Department for retraining. These 55 operators were involved in 171 preventable accidents in a six-month period prior to the medical investigation. They were involved in only 28 preventable accidents in the six-month period immediately after the training and medical treatment. The other 156 accident repeaters were not referred to the Medical Department for study because their accidents were not serious enough. However, they were made to attend special safety hearings. These 156 repeaters had 585 accidents during the six months before the study. They were involved in 451 accidents in the six-month period immediately after their safety investigations. This shows that the hearings alone did not accomplish the same improvement as medical study, treatment, and retraining.

Tables II and III show the number of new illness and compensation cases seen in the clinic annually for the past three years. Table II shows a decrease of 50% in the number of new illnesses, from 2,167 in 1948 to 1,075 in 1950. It should be noted that while there was a reduction in the number of respiratory infections from 685 in 1948 to 336 in 1950, there was no decrease in the percentage. Respiratory infections accounted for 31.6% of new illnesses in 1948, and 31.1% in 1950. However, with the gastro-intestinal cases the results were different. Not only did the number of new cases fall from 238 in 1948 to 81 in 1950, but the percentage was

TABLE II.
ANNUAL INCIDENCE OF NEW ILLNESS CASES

| | 1948 | | 1949 | | 1950 | |
|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % |
| Respiratory disease | 685 | 31.6 | 413 | 26.5 | 336 | 31.1 |
| Surgical | 184 | 8.5 | 146 | 9.3 | 90 | 8.4 |
| Muscle joint tendon (non-traumatic) | 210 | 9.7 | 147 | 9.4 | 123 | 11.3 |
| Trauma | 161 | 7.4 | 128 | 8.2 | 63 | 5.9 |
| Cardiovascular-renal | 86 | 4.0 | 38 | 2.4 | 43 | 4.0 |
| Metabolic-endocrine | 52 | 2.4 | 46 | 2.9 | 13 | 1.2 |
| Allergy | 33 | 1.5 | 28 | 1.8 | 13 | 1.2 |
| Psychogenic | 66 | 3.0 | 55 | 3.5 | 29 | 3.0 |
| Gastro-intestinal | 238 | 11.0 | 168 | 10.7 | 81 | 7.5 |
| Skin | 58 | 2.7 | 60 | 3.8 | 59 | 5.5 |
| Ears, nose, throat, eyes | 212 | 9.8 | 204 | 13.1 | 113 | 10.5 |
| Miscellaneous | 182 | 8.4 | 131 | 8.4 | 112 | 10.4 |
| Totals | 2,167 | 100. | 1,564 | 100. | 1,075 | 100. |

TABLE III.
ANNUAL INCIDENCE OF NEW COMPENSATION CASES

| | 1948 | | 1949 | | 1950 | |
|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % |
| Abdomen and genitals | 24 | 4.4 | 23 | 5.7 | 15 | 5.7 |
| Back | 45 | 8.3 | 36 | 9.0 | 21 | 7.9 |
| Extremities and joints (non-fractures) | 284 | 52.9 | 181 | 45.2 | 106 | 40.1 |
| Chest | 26 | 4.8 | 27 | 6.8 | 7 | 2.6 |
| Ears, nose, throat, eyes | 79 | 14.7 | 65 | 16.2 | 39 | 14.7 |
| Head injuries | 49 | 7.5 | 29 | 7.3 | 13 | 4.9 |
| Peripheral nerve and miscellaneous | 6 | 0.1 | 9 | 2.3 | 7 | 2.6 |
| Skin | 5 | 0.09 | 13 | 3.3 | 35 | 13.2 |
| Fractures | 27 | 5.0 | 17 | 4.2 | 22 | 8.3 |
| Totals | 536 | 100. | 400 | 100. | 265 | 100. |

reduced from 11.0% in 1948 to 7.5% in 1950. The fact that the percentage of gastro-intestinal cases fell while the percentage of respiratory diseases remained unchanged is significant.

Table III shows that the total number of compensable cases was reduced from 536 in 1948 to 265 in 1950, a reduction of 50%. An interesting sidelight is the increase in percentage and number of skin cases from .09% (five cases) in 1948 to 13.2% (35 cases) in 1950. This may be associated with the increased exposure to Diesel oil, with the conversion from trolley to bus operation.

## Comment

THE purpose of a Medical Department in the transportation industry, in addition to the care and maintenance of health, should be accident prevention and public safety. We have shown, in a previous communication,[2] the beneficial effects of proper pre-employment examinations of bus operators on accident prevention. The results reported in our present study reveal the importance of medical and safety supervision of operators.

In order to maintain a low accident rate, it frequently becomes necessary to transfer bus operators to other jobs because of organic or psychiatric disease. This change may be permanent or temporary depending on the type of illness.

ORGANIC MEDICAL DISEASES: Little need be said about the transfer of bus operators with obvious defects such as poor vision, epilepsy, or deafness. The major problem lies in determining what conditions are incompatible with driving, on the basis of public safety as well as the health of the bus operator. Each patient must be considered individually.

Frequently the ability to drive a bus is unrelated to the gravity of a disease. For example, we recently had under our care operators with carcinoma of the rectum, mediastinal lymphoblastoma, and lymphosarcoma of the small intestine. These patients were able to continue as drivers for from four months to a year after the diagnosis was made. They were permitted to drive, since we felt that they were entitled to a reasonable opportunity to maintain their independence and self respect in a job which was not dangerous to their health. None of them was involved in accidents.

On the other hand, there is a group of relatively innocuous diseases which have a great influence on bus operation. Among these we must include pilonidal cysts, hemorrhoids, fistulae, intertrigo, and other skin conditions. Bus operators who have these conditions develop physical discomfort and irritability because they are required to sit for long periods of time. This causes decreased concentration and stability and predisposes to accidents. Correction of these defects is followed by return to bus operation.

There are others with medical conditions which carry a potential danger because of the possibility of sudden loss of consciousness. These include the diabetics, cardiacs, and hypertensives. Diabetics are permitted to drive as long as they do not take insulin. Diabetic ketosis occurs gradually and, with its premonitory warning signs, there is ample time to seek medical attention. However, insulin shock may develop suddenly, and with little or no warning. It is too hazardous to risk.

It is impossible to determine which individuals in the older age group will sustain a coronary thrombosis or cerebrovascular accident. We feel that those who have had a previous episode are potentially greater hazards. Therefore we do not permit bus operators who have had these illnesses to return to driving. They are studied carefully by our internists and, depending on their cardiac reserve, and the degree to which they have been rehabilitated, sedentary light work is recommended. This job placement is a necessary duty of industry for humanitarian reasons as well as for increased productivity.[4]

PSYCHIATRIC CONDITIONS: There is a direct relationship between the mental and emotional health of operators and their proneness to frequent accidents, as shown by several recent surveys.[5] Moorad[6] quoted statistics to show that 85-90% of all accidents are due to "human factors."

Our own statistics have shown how we were able to reduce the accident rate in the Third Avenue Transit System by proper medical care. This medical care was directed at the correction

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not only of physical, but also emotional defects in our bus operators.

One of the most important therapeutic measures has been skilled listening on the part of our physicians. Good rapport was obtained by treating the operators as human beings, paying attention to their personal, family and social conditions, as well as their medical problems. In this way, we were able to diagnose and correct many difficulties which were leading to emotional instabilities and somatic complaints. Minor readjustments of working schedules (day or night driving), or leaves of absence or vacations, have been recommended by the Medical Department in an effort to correct these emotional problems. This has led to improvement in many cases, with a reduction in absenteeism, a better morale, and a resultant decrease in accidents.

The major psychiatric diseases, such as schizophrenia, manic-depressive psychosis and cerebral arteriosclerosis, do not pose a great problem except in prompt and proper diagnosis. In order to be given the opportunity to make these diagnoses, it is important that the Medical Department examine the employees. Therefore, we must do our utmost to maintain good relationship with the workers, the union, and the private physicians.

Once a diagnosis of any of the major psychiatric diseases is made, patients are not permitted to return to bus operation. After treatment, they are allowed to work in some other capacity if their condition warrants.

Alcoholism presents a tremendous problem in industry. Bacon estimated that approximately 2,890,000 of the four million alcoholics in the United States are men between the ages of 30 and 60, and about 1,370,000 "chronic excessive and compulsive drinkers are fairly regularly employed in industry."[7] Alcoholism is an illness related to emotional stress, instability, and insecurity. It leads to a high rate of absenteeism. When alcoholism is discovered, our patients are studied in an effort to uncover the etiological factors. An attempt is made to have the patient undergo psychotherapy. He is transferred to another job, such as that of porter or bus cleaner.

The alcoholic is an obvious hazard to public safety if permitted to operate a bus or trolley. His judgment, reflexes, vision, stability, and other faculties are impaired. A more subtle reason for potential danger is his high rate of absenteeism. This causes overwork and fatigue on the part of the other operators in their effort to maintain effective schedules.

## Economic Results

IN THE 1950 Annual Report to Management, the Medical Department was shown to have effected a financial saving of almost $100,000 per year since its reorganization. This was due to decreased absenteeism, with resultant reduction in sick pay and a reduction in compensation costs. This does not include the unknown sums saved in decreased liability claims by accident reduction.

In comparison to these large savings and the improved health of employees and improved public safety, the cost of maintaining a good medical department is exceedingly small.

## Summary

1. THE effect of an extended medical service program in a large surface transportation company is reported.

2. This medical program included adequate clinic facilities for on-the-job medical treatment; careful pre-employment examinations; meticulous study of medical absences; study of all accidents, and periodic examinations of bus operators.

3. The improved medical care resulted in a decrease in the number of illness and compensation cases, and a reduction in the accident rate.

4. This program resulted in a financial saving for the company of approximately $100,000 per year.

5. Cooperation between the Medical and Safety Departments in the study of accidents and in retraining and correction of medical deficiencies is essential.

6. In view of the improved health of the employee, improved public safety, and the large financial savings effected, the cost of maintaining a good medical department is exceedingly small.

[NOTE: The authors wish to express their appreciation and gratitude for the assistance and cooperation given by EDWARD FLAMM, Assistant Engineer, Third Avenue Transit System.]

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# The Therapeutic Use of Oxygen in Industrial Medicine

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THERE is a precious atom called oxygen without which life cannot exist. The first challenge that faces us at birth is the attempt to breathe, while there is no more manifest sign of death than the cessation of respiration. It has been said that probably no malady so fills the human being with alarm as that which interferes with the comfort of breathing. Yet, in normal man breathing takes place with such little effort that he is generally unaware that the body mechanism is more thirsty for oxygen than it is for any other element. How many individuals carrying on their normal pursuits are aware of the fact that complete deprivation of oxygen results in unconsciousness within 60 seconds and death in less than 10 minutes!

It has been generally accepted that provision for the administration of oxygen is a requirement for the well-equipped industrial first aid station or industrial medical department. Unfortunately, this equipment has been maintained and utilized principally for the treatment of cases of acute asphyxia and as a treatment of last resort for a variety of terminal conditions. Experience has shown that there is a much wider application for this valuable gas than is often appreciated. It can be used to advantage for many industrial exposures, not only as a therapeutic agent but also as a prophylactic measure to prevent complications resulting from such exposures. Johnstone,[1] referring to oxygen therapy, states, "While general medicine has accepted this type of therapy, industrial medicine has not utilized it to a degree warranted."

Exposure to noxious gases or fumes may result in damage to lung tissue so that it is incapable of handling the exchange of oxygen from the atmosphere to the blood stream. These gases or fumes may provide an atmosphere deficient in oxygen, or they may combine directly with the blood or tissue to the exclusion of oxygen. It is of interest to note that in cases of exposure to many noxious gases or fumes the changes found in the lungs following an undue exposure are not unlike the changes noted in the lungs of persons with various respiratory and cardiac diseases of non-occupational origin. For these respiratory and cardiac diseases, oxygen is widely used in treatment, since they are associated with the inability of the lungs to diffuse oxygen into the blood stream, or the inability of the blood to carry an adequate amount of oxygen to vital tissues. In both the occupational and non-occupational conditions there is a lack of oxygen, or anoxia, and, to combat this anoxia, oxygen is of proved value. It has also been demonstrated that oxygen administered promptly after exposure to certain irritant gases relieves the symptoms promptly and prevents complications due to the exposure.

In almost any given industrial plant an appraisal of the materials handled and processes involved should present a picture as to what sort of exposure to noxious gases or fumes might be anticipated. Accidental spillage of certain acids, for example, can result in serious exposures, yet under normal methods of handling there would be no hazard. A quantity of nitric acid spilled on wood or some sawdust in a confined space can result in the evolution of oxide of nitrogen fumes in quantities sufficient to cause severe injury.

There is available a detailed classification of noxious gases in the monograph, "Noxious Gases," by Henderson and Haggard, published in 1943. The following excerpts give a classification of irritants, asphyxiants, and anesthetics, based on morbid physiological response to them.

"I. IRRITANTS:

A. Those affecting mainly the upper respiratory tract. *Examples:* Ammonia, hydrochloric acid, sulphuric acid, hydrofluoric acid and acetic anhydride.

B. Those affecting the upper respiratory tract and also deeper structures, such as the bronchi. *Examples:* Chlorine, sulphur dioxide, bromine and iodine.

C. Those acting primarily upon the lungs and to a less extent upon the upper respiratory tract. *Examples:* Ozone, nitrogen dioxide (nitrous fumes), phosgene.

D. Organic vapors which do not follow the general rule as to solubility in relation to location of action. *Examples:* Acrolein (acrylic aldehyde), dimethyl sulphate, halogenated organic compounds.

II. ASPHYXIANTS:

A. Simple. These act primarily because when exposure to these gases occurs there is either insufficient or no oxygen present. *Examples:* Nitrogen, hydrogen, helium, methane, ethane, propane, and acetylene.

B. Chemical Asphyxiants. These are probably the most important of all because they are responsible for more deaths than any other class of noxious gases. *Examples:* Carbon monoxide, cyanides and cyanogen compounds. Carbon monoxide is an asphyxiant because it has a property of combining with the hemoglobin of the blood and excluding the oxygen from the hemoglobin. Cyanide is an asphyxiant because it acts upon the tissues and temporarily deprives them of the capacity to use oxygen which the blood brings.

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III. VOLATILE DRUGS AND DRUG-LIKE SUBSTANCES: The one physiological action common to these substances is that of inducing symptoms of anesthesia when inhaled in a sufficient quantity. *Examples:* Ethers, gasoline, chlorinated hydrocarbons, methyl alcohol, and many others."

IRRITATING gases and vapors differ widely in chemical and physical properties. They have one physiological property in common, namely, they induce inflammation in tissues with which they come into direct contact. The inflammation or irritation caused by these materials is not the same as that produced by simple chemical corrosion. The inflammation develops from the disturbance in normal vital processes in the tissues, such as coagulation, liquefaction, dehydration, upset in cellular metabolism, or some other type of injury. The type of direct injury caused by the gas or vapor is often too slight to be seen and depends upon the chemical nature of the irritant.

There is no apparent correlation between the similarity of action of irritating vapors and the symptoms produced by exposures. The differences in symptoms are mainly due to differences in the localities at which the irritants act. Some irritants act primarily upon the upper respiratory tract and induce rhinitis, pharyngitis and laryngitis. Others extend their action to the bronchi and cause bronchitis and bronchopneumonia, while still others act chiefly on the lungs themselves, causing pulmonary edema, pneumonitis, or pneumonia.

The location in the respiratory system exposed to an irritant gas or vapor influences the symptomatology and pathology. As an example, an exposure to ammonia gas in high concentrations is followed by intense congestion and swelling of the upper respiratory passages and possibly rapid death from spasm or edema of the glottis or larynx. If the immediate effects are survived, there may be little or no pulmonary damage, since the deeper structures of the respiratory tract are not reached and therefore are not injured. In contrast, phosgene and nitrogen dioxide, even in concentrations which may later be lethal, cause comparatively little immediate irritation of any of the mucous membranes of the respiratory tract but induce pulmonary edema through their action on the deep lung structures, such as the alveolar membrane of the lung itself.

SEVERAL papers have been published in recent years concerning the utilization of oxygen for industrial exposures. It has been emphasized that oxygen for industrial exposures should be administered as promptly as possible after the exposure. In industries where there exist inhalation hazards which present a need for oxygen, the industrial medical dispensary should be equipped to administer oxygen promptly. To illustrate the importance for quick action, fumes such as oxides of nitrogen can produce a fatal pulmonary edema several hours after exposure, and the victim will not be aware of much discomfort until the edema has begun. After a severe pulmonary edema is established it is difficult to control. However, this edema can be prevented by the prompt administration of oxygen after exposure to the oxides of nitrogen. The administration of oxygen to prevent pulmonary edema should be given with a positive pressure of 4 cm. of water for 30 minutes out of each hour, and continued for several hours. This technique is well described in the Manufacturing Chemists' Association Safety Data Sheet No. SD-5, Nitric Acid. It has also been described by Carlisle.[2]

Another example of the importance of prompt administration of oxygen can be observed in chlorine gas exposures. This is one of the more common of the irritating gases to which individuals are exposed, because of its extensive use. It is so irritating that an exposed individual usually withdraws before severe gassing can take place. The inhalation of chlorine gas produces a prompt pulmonary irritation with resulting severe paroxysms of coughing, a sense of discomfort in the chest, nausea, vomiting, and edema of the lungs may occur after a severe exposure.

When oxygen is administered promptly within 10 or 15 minutes after exposure, the response of the patient is dramatic, as the coughing usually subsides in five minutes and the patient is quite comfortable. Two hundred and fifty cases of exposures to chlorine were reported by the author in 1949.[3] These occurred over a period of five years and they responded to oxygen therapy with a minimum of latent complications, such as bronchitis and other manifestations of pulmonary irritation. Early in this series the cases were treated by the continuous inhalation of a concentration of oxygen approaching 100% by means of an oro-nasal mask at normal atmospheric pressure. This treatment was later modified, using an injector-type mask metered for positive pressure. This mask can be regulated so that the patient exhales against a positive pressure as desired, corresponding to 1 cm. to 4 cm. of water. This same mask can also be used to administer oxygen at atmospheric pressure. A practical point to remember is that, in utilizing a positive pressure mask, begin to administer the oxygen at atmospheric pressure and gradually increase the pressure up to 4 cm. of water. Patients will object to the positive pressure at the start.

It usually takes 20 to 30 minutes' treatment for the average case of chlorine exposure, but in the more severe exposure the treatment is continued for an hour. Shortly after the high concentration of oxygen is begun the coughing subsides and, as the patient becomes more comfortable, the percentage of oxygen can be gradu-

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ally reduced. If coughing returns, the percentage of oxygen is increased. The development of further signs and symptoms is an indication for continuing oxygen therapy.

In a personal communication, the Medical Director of a large chemical plant reports that they treated 11 cases of chlorine exposures in 1950 and 17 cases the first half of 1951. He reports that the relief of symptoms of chlorine exposures by concentrations of oxygen approaching 100% under pressure has proved to be dramatic, and it has generally been found that approximately one hour of therapy will suffice the average chlorine exposure. Further, there have been no instances of pulmonary edema when this treatment is carried out. It is not recommended that pressures exceeding 4 cm. water be administered, as pumonary complications may occur, and this level seems sufficient and yet is safe to use.

As an example of what may happen to a case of chlorine exposure where there was no benefit of oxygen therapy, an individual was involved in an exposure and did not report to the Medical Department. He was seen three days after exposure with symptoms of severe acute bronchitis and, from the history, it was possible to conclude that in the six-hour period following exposure to chlorine he had experienced a mild attack of pulmonary edema.

At this same plant they have noted that the same rapid relief is experienced when exposures to other irritating materials are treated with oxygen under positive pressure. Also they have seen rapid improvement following exposures to ammonia, acetic anhydride, and croton-aldehyde vapors. Their conclusion is that the mechanism of this relief and improvement after oxygen therapy is not understood, but that it exists cannot be questioned. These cases illustrate that the immediate prophylactic use of oxygen probably prevented many more severe complications than would have occurred had one waited for pulmonary edema, bronchitis, etc., to develop before the administration of oxygen.

In a personal communication from the Medical Director of another large plant, he reports that they had found it necessary to administer positive pressure oxygen 21 times during the past year. They routinely administer oxygen to all individuals exposed to irritant gases in whom there is either subjective or objective evidence of irritation of the lower respiratory tract. An incident occurred at this plant recently in which six men were accidentally exposed to a massive exposure of zinc chloride fumes. Four of these men had objective evidence of beginning pulmonary edema which was quite promptly reversed by positive pressure oxygen, and all six recovered uneventfully without losing time. A roughly similar British exposure resulted in several fatalities.[4]

Exposure to extremely fine sodium oxide fumes results in marked pulmonary irritation. The sodium oxide combines with the moisture in the pulmonary tracts and forms sodium hydroxide which has an irritating action on the mucous membranes of the respiratory tract. A report on 21 cases of exposure to sodium oxide fumes shows that oxygen afforded prompt relief to these cases.

CERTAIN metal fumes are capable of producing lung irritation, and cadmium, of all the various metal-fume exposures, seems to stand out as being capable of producing delayed lung changes. The lungs seem to bear the brunt of the assault from the inhalation of the fumes. There is little irritation of the upper respiratory system, and usually the first symptom noted is a dryness of the throat and a feeling of soreness in the chest. This is followed by cough, with headache, and dizziness. After 12 to 36 hours there occurs severe constricting pain in the chest, and marked dyspnea. This delay is comparable to that seen in phosgene and nitrogen dioxide poisoning. Death may occur from undue exposure to cadmium fumes. While we do not have available any reports upon the use of oxygen exhaled against pressure in such cases shortly after an exposure to cadmium fumes, from the symptomatology and clinical findings, oxygen therapy would be expected to be a treatment of choice for such exposures.

While time is important in cases of exposure to irritants, cases of exposure to asphyxiants, of course, require oxygen more promptly. In cases exposed to asphyxiants, positive pressure breathing is not necessarily required. In such cases in which breathing has stopped, artificial resuscitation should be started at once, and oxygen should be administered while the artificial respiration is in progress. One of the more common chemical asphyxiants encountered is carbon monoxide. This gas actively produces an anoxia when inhaled in sufficient concentrations. The relative severity of exposure can be judged by testing the blood of victims by the pyrotannic acid method. This test indicates the percentage of carboxyhemoglobin or carbon monoxide saturation in the blood. In a report received on 25 cases of carbon monoxide poisoning which occurred over the past three years in one plant, it was found that these cases had a carbon monoxide saturation varying from 20% to 60% according to this test. Oxygen was administered promptly, and recovery was uneventful in all these cases. The duration of the oxygen therapy varied from 30 minutes for the less severe exposures to two hours for the more severe ones. The recovery in all these cases was uneventful and without complications. Treatments in severe asphyxiant cases are generally longer than simple irritant cases because often the brain and breathing centers of the central nervous system are affected by anoxia, and a rich supply of oxygen is necessary for hours or days.

What has been said of the treatment for the

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chemical asphyxiant, carbon monoxide, is equally true for the simple asphyxiants. Oxygen given promptly results in rapid response and freedom from complications.

It is frequently impossible to ascertain the degree of exposure to a noxious gas or fume. For this reason it is safe to assume that if an exposure exists, the victim should be given the benefit of the doubt and should receive oxygen.

In the industrial plant there are many other conditions that can occur to employees besides exposures to noxious gases and fumes that are indications for oxygen therapy. To mention a few, it is an established form of emergency treatment for acute heart attacks, such as coronary occlusion. Severe traumatic conditions presenting evidence of shock, such as fractures, head injuries, and severe burns, are indications for the prompt administration of oxygen. It has also been of proved value in electrical shock as well as heat stroke.

The widespread use of oxygen in hospitals, institutions, by rescue teams, and even in the home, is adequate proof as to the safety in its use when reasonable precautions are taken. It is essential, however, that oxygen should be administered by an attendant who understands the operation of the oxygen equipment. Oxygen should be given in an indusrtial Medical Department only by a physician, or by a nurse, or a qualified first aid attendant who is trained in its administration and is working under the supervision of a physician.


## Summary

IT IS the intent of this paper to emphasize some of the indications for oxygen therapy in industry.

This versatile therapeutic agent is capable of affording relief from many exposures due to noxious gases and fumes, while at the same time decreasing the incidence of complications.

The value of oxygen therapy as a prophylactic measure cannot be over-emphasized.

Oxygen has proved to be a life-saving medium when provided promptly in cases of acute asphyxiation.

Oxygen has been proved to be just as valuable a therapeutic agent for many occupational conditions as it has been for non-occupational diseases and conditions.


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## Effort Before Hiring

ALMOST recent industrial problem of urologic nature, one that will be met with more and more often because of the atomic age is uranium nephritis. Uranium salts are absorbed very readily through various channels into the body. They circulate there and are quite harmless as long as they are the alkaline salt of uranium. They move through the body in combination with bicarbonates and gradually accumulate in the liver and fat tissue. They re-enter the circulation in dilute form. As they pass through the kidney tubules, however, the bicarbonates are reabsorbed as the body conserves the alkaline ions to maintain itself in electrolyte balance, and the uranium remains in the tubules as an acid salt. It promptly sets up a necrosis in the distal convoluted tubule, and the picture of a lower nephron nephrosis ensues. The effect is similar to that seen with other heavy metals. A number of cases of this type of nephritis have been reported. As the search for uranium deposits increases and the atomic age brings more people into contact with uranium this problem will be seen more and more often and will have to be safeguarded against. Fortunately, the presence of even small amounts of uranium in the urine can be readily detected—in fact it is a good method of evaluation of the amount of uranium in the body—and so a ready check can be effected for industrial purposes. Before leaving the chemical effects of various agents on the kidney and bladder I would like to mention a practical aspect of these problems. I believe that renal lesions could be handled much more readily if all employers would screen their employees more carefully before hiring them, especially in occupations that may have some inherent hazard such as copper mining, smelter work, heavy metals industries, etc. A recorded urinalysis, blood pressure, flat plate of the abdomen for stone, and a careful history would be of tremendous help in evaluating all cases should they come before a commission. The effort expended before hiring would be a great help before firing.

—From "Industrial Urology," by PAUL L. SINGER, M.D., in *Arizona Med.*, 9:2, 31 (February) 1952.

# The Use of Hemo-Irradiation (Knott Technique) in Eye Infections

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IN AUGUST, 1950, the authors became interested in the effect of ultra-violet blood irradiation on various infections of the eye.[2] A case of irido-cyclitis was selected for the initial study and the results of the treatment of this case were so outstanding that encouragement was found not only to continue the study, but even to enlarge the projection of the original investigation. All of the work so done has been on private patients and, therefore, subject to the limitations placed upon research work carried out in a private institution upon private patients. The personnel of the Blood Bank at Little Company of Mary Hospital must be thanked for the part they have played in making this work a success. The technicians of this department have been responsible for the proper cleaning, sterilization and preparation of the technical aspects of the therapy.

Many of the cases that have been treated with UBI (ultra-violet blood irradiation) had previously been treated unsuccessfully by conventional means. A concomitant series was followed for comparative purposes, using antibiotics, Cortisone, Antigen-H, and triple typhoid vaccine. All cases treated with UBI responded exceptionally well, except for one, an irido-cyclitis, which also failed to respond to conventional therapy. This case gradually underwent a dissolution and no form of therapy can be given credit as an aid.

A comparison of the cases of irido-cyclitis treated with UBI and conventional therapy shows a marked difference in the end results. The outstanding point in this comparison is that the cases treated with UBI were singularly free of sequelae, such as posterior synechiae (adhesions of the iris to the lens), exudates on the anterior lens capsule, heavy keratic precipitates, with the attendant loss of vision. The above-named sequelae were present, and of a permanent nature, in 30% of the control group. In the series treated with UBI, which includes a case of sympathetic ophthalmia, a form of uveitis noted for its plastic inflammation and adhesive tendencies, there was complete freedom from sequelae. As one would expect, with the absence of these complications, there was no case that showed a reduced visual acuity due to the irido-cyclitis in the series treated with UBI.

THE most outstanding case of the series was the one of a true sympathetic ophthalmia, following a cataract extraction. This occurred in a 53 year old white male with a cataract of the right eye and an incipient cataract of the left eye. On October 18, 1950, the cataract of the right eye was removed with the surgical complication of marked loss of the vitreous humour with subsequent prolapse of the iris. Considering the surgical complication, the patient experienced a highly satisfactory post-operative convalescence and on November 14, 1950, his manifest vision was 20/60. On November 18, 1950, the patient noticed pain and visual disturbance in the left (unoperated) eye. By November 21, 1950, his vision was reduced to counting fingers at a distance of one foot. He felt that he was blind. Slit-lamp examination showed heavy keratic precipitates and the heavy adhesions of a true plastic iritis. The operated eye was still clear, probably due to the local Cortisone which had been used postoperatively. When the complicating pathology was discovered the patient was immediately hospitalized, and UBI and systemic Cortisone therapy were begun. The combined therapy was started because it was felt that every possible effort should be made to save the eye. The Cortisone dosage was 100 mg. every eight hours for 48 hours. The dosage was then reduced to 100 mg. twice daily. The UBI therapy was started simultaneously with the intramuscular Cortisone. After 1400 mg. of Cortisone and four UBI treatments his vision was 20/40 in the sympathizing eye. The entire picture continued to improve from this point and on December 11, 1950, 23 days after the onset of the sympathetic ophthalmia, the vision had returned to normal and so remains. Since December 11 this patient has been examined several times and there is no evidence of conjunctival injection, posterior synechiae or residual K.P. bodies.

The following table shows the types of cases treated in this survey. In all cases, except one, the sympathetic ophthalmia, there was no concomitant antibiotic, foreign protein, or Cortisone therapy. In the excepted case Cortisone was administered simultaneously, and the UBI dosage was cut by half because of fear of overstimulation of the adrenal glands.

The plan of treatment followed in all instances

| Type of Infection | Total Cases Treated | No. Treated with UBI | No. treated Conventionally | No. treated with combined therapy |
|---|---|---|---|---|
| Irido-cyclitis | 28 | 18 | 10 | |
| Uveitis complicated by glaucoma | 3 | 3 | | |
| Retro-bulbar neuritis | 3 | 3 | | |
| Herpes zoster ophthalmicus | 1 | 1 | | |
| Keratitis | 1 | 1 | | |
| Sympathetic ophthalmia | 1 | | | 1 |

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(except the one case where the UBI dosage was merely reduced 50%) was to withdraw a specified amount of blood (1.5 cc. per pound of theoretical average normal body weight) from the patient's vein into a Baxter vacuum flask containing sodium citrate solution. This blood was then passed through the Knott Hemo-Irradiator where the citrated blood is exposed through a quartz glass window to ultra-violet rays of selected wave lengths and intensity. The rate of exposure and delivery into the patient's vein is 10 cc. every 20 seconds. This is the same plan that is used ordinarily in treating infections anywhere in the body with UBI, and is commonly referred to as the Knott technique. Treatments were given on the basis of one every other day until three treatments had been given. The case was then re-evaluated by the attending ophthalmologist, and if necessary, further treatments were given. In this series we found that the average number of treatments required to produce the desired results was five. The fewest number in any one case was three. It was found that the greatest number of treatments necessary in any one case to produce beneficial results was seven.

One of the outstanding subjective symptoms present in irido-cyclitis is pain. In the UBI series of cases the pain was relieved to the point where the patient was comfortable in an average of 10.6 hours.

A comparative study of the time required for a case to be discharged by the attending ophthalmologist was 17.5 days in the case of the patients treated with UBI, and 30.8 days as an average before a case could be discharged that had been treated with conventional therapy.

The average age of the patients treated in the UBI series was 47.4 years, and 46.0 years in the conventionally treated cases. Both series cover a wide range of ages, from 20 to 74 in the UBI series, and from 20 to 70 in the comparative group.

IN EVIDENCE of the outstanding results that have been obtained in treating infective processes of the eyes, we present the following typical case histories:

Miss C.F., white, 53 years of age, was first seen on October 5, 1950, at which time she complained of pain in the left eye of two days' duration. Vision in the right eye was 20/20, and in the left eye 20/20. Near vision was J2 in both eyes. Examination revealed a mild ciliary injection; the pupil was round and reacted to light. Slit-lamp examination showed no flare. There were no cells in the chamber. She was given a prescription for chloromycetin locally. When seen on the following day at which time the slit lamp revealed a definite flare and cells in the anterior chamber, she was put on atropine therapy and a search for foci of infection was begun. She received her first hemo-irradiation on October 7, 1950, and marked relief of pain was noted that same evening. It was repeated on October 9. Two apical abscesses were found on this day and the teeth were removed. On October 10 the aqueous was so heavy that it resembled a cobweb. Another UBI was given on October 11 and the patient began to improve so that by October 16, 1950, there was only a slight flare. The eye lost most of its congestion. There were a few cells in the anterior chamber, and many small pigment reciprocates were on the endothelium and anterior capsule. The patient had one more treatment on October 20 and was examined later that day. There were still cells in the chamber, but they were fewer in number; the K.P.'s were diminishing. She was seen again on October 23 at which time the eye was white and only one or two cells could be seen in the anterior chamber; thusly the patient was discharged. Her vision was identical on discharge to what it had been at the onset of the disease.

A more dramatic result was seen in the case of Mr. E. McM., age 20, white. He was first seen on December 21, 1950, with a history of having had an attack of irido-cyclitis a year previously that ran a course of six weeks. A tonsillectomy had been done about one month after the eye infection had cleared. Since that time he had had no symptoms until four days before coming to the office, when he noticed that the right eye became blurred when reading. For two days before coming for treatment the right eye was red and painful. His vision was 20/20 on the left and 20/30 on the right. Examination revealed a mild congestion of the bulb, many pinpoint K.P.'s, aqueous flares, and a chamber full of cells. There were no synechiae. The patient was atropinized and received UBI on December 22, December 24, and December 26, 1950. On December 26 the slit-lamp examination revealed many cells in the chamber but no motion. The iris was free. By January 2, 1951, there was a clearing of the cells and a convection current was present. The eye was white. By January 9 only an occasional cell was seen and vision had returned to 20/15 in both eyes.

The very first case that we treated is another outstanding example of the beneficial effects of UBI in treating irido-cyclitis. This was the case of Miss G.K., 41, white, who was first seen on August 29, 1950, with a history of her right eye "being sore" for four days and gradually growing worse. With the right eye she was able to count fingers at a distance of one foot; left vision was 20/20. Examination revealed an intensely congested bulb on the right with an irregular pupil. Slit-lamp revealed a muddy chamber, exudate on the anterior capsule and almost complete synechiae. An effort was made to restore the pupil with atropine, neo-synephrine and cocaine. Antigen-H was given intravenously. Salicylates and antibiotics were started and the patient was immediately hospitalized. The work-up, including all focal infections and tubercular sensitivity, was negative. Therapy included

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penicillin and chloromycetin, calcium gluconate and triple typhoid vaccine intravenously. This therapy was stopped on September 2, 1950, as no improvement was noted. By this time her pain was severe in the right eye; chemosis was increasing. The chamber was heavy with exudate. Late that afternoon the first UBI was given. Next morning at rounds the patient was greatly improved and she stated that she had rested quite comfortably during the night. The chemosis was much less; the bulb, although still injected, was improved. Subjectively, the patient was free of pain and smiled for the first time in several days. On the next day, September 3, 1950, she was again improved, with the anterior chamber being much clearer. The numerous deposits of exudate and iris pigment were now visible on the anterior capsule. The following day, another UBI was given. On September 6 another treatment was given and it was noted that the detritus in the chamber continued to clear. Bulbar congestion had been reduced to a faint blush, and it was felt safe to discharge the patient. No synechiae were remaining and vision was 20/20.

A Mr. L.W. was a case of retro-bulbar neuritis of three days' duration who came in with a vision of 20/60 in the right eye, and 20/80 in the left eye. He was first seen on April 10, 1951, and after three UBI treatments was discharged on April 27, 1951, with a visual acuity of 20/20 in the right eye and 20/15 in the left eye.

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## The Field That Challenges

THE question of shortages of doctors has been agitated a good deal lately. The present shortage in medical manpower is due not to curtailment in the numbers of medical students, as has been said in ignorance, but to the fact that there are now a great many more things that doctors are called upon to do. Service in industry is only one of them; government services, insurance companies, private and public funds and foundations, universities and others who have little or nothing to do with sick people are all anxious to adapt medicine to their own particular purposes. This is all because medicine has become a social instrument and can be effectively used as such. When we turn to industrial health as a science, we find ourselves in a field that challenges more directly the interest and skill of all practitioners of medicine. As Dr. Strong pointed out to this assembly in Boston a year ago, industry is "vitally interested in the increasing incidence of coronary disease and in the tendency to award compensation to a greater percentage of these cases." Gastroenterologists, psychiatrists and others may be likewise involved in the application of our knowledge of cause and effect to occupational environment. Much of today's medical care revolves about things which, although they may be non-industrial in origin, can nevertheless become industrial liabilities, and our scientific knowledge of etiology may then become decisive. Not only in the heavy and large industries, but in the small plants as well, there lurk many of those rewards that bring joy to the heart of the diagnostically inclined physician. Lead poisoning, that syphilis of industrial medicine, is always possible in the wake of the ever-widening use of this now precious metal. Such new and exciting diseases as those following exposure to beryllium have been recognized as hazards in small plants as well as large. A medical awareness of the fact that dusts and other atmospheric pollution, both in and out of doors, may aggravate conditions to which large numbers of people are predisposed, could go a long way toward civic and industrial control of those unpleasant and probably harmful contaminants with which most large cities are now plagued. There are a great many interesting and desirable results to be expected, when and as medical interests and services appear in our industrial life. At first they may appear as by-products, but in American business by-products frequently become main products, and so it could be with services like these.

—From "The Meeting-Place for Industrial Health," by DWIGHT O'HARA, M.D., F.A.C.P., in *Ann. Int. Med.*, 36:2, 565 (February) 1952.

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# The Nurse on the Industrial Medicine Team

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AS RECENTLY as 1941, when industrial nursing, with its 6,244 R.N.'s, was beginning to feel the impetus of a second World War, many decried what was then called a fly-by-night profession. With production schedules soaring by geometrical progression and the labor supply dwindling, manufacturers began to manifest their demand for a service that would enhance the desire and the ability of workers to stay on the job. But how could factories with their bedlam of whirring machines, staccato pounding of riveting hammers, and frequently decadent vicinage with attendant grime, confusion and disagreeable odors, lure the registered nurse from her dignified, but often modestly paid employment in a hospital? Graduates who had attained coveted positions through exacting study and sacrifice were little disposed toward risking their security. Even as nurses were humming the then popular "Rumors Are Flying," word got about that industry offered regular hours, less fatiguing work, employee benefits such as social security, group medical and life insurance plans, and salaries consistent with those of other workers having comparable skills and training. Those who were inspired asked such questions as, "What kind of nursing is it? What are the duties?" Unless these inquiries were directed to the personnel interviewer of a prospective employer the answers were likely to be evasive and confusing. The reason was that there are several classes of industrial nurses, including those employed in factories, construction work, department stores, and publishing firms. If an airline stewardess is a registered nurse she also falls into this category.

In spite of this, nurses who made the apparently temerarious decision to enter industry found this field of endeavor excitingly different, yet fully reliant on their training and experience to administer to the ill and injured and to maintain the morale of the healthy. This was a new facet of nursing—with emergency treatment taking precedence over bedside nursing, and the causes of hospitalization repeatedly nipped at their source. A new outlook, indeed, where nursing and medicine both stress the axiom "an ounce of prevention is worth a pound of cure!"

INDUSTRY'S first nurse was Miss Ada Mayo Stewart, who in 1895 was employed by the Vermont Marble Company. The president of this concern, Fletcher D. Proctor, was profoundly interested in the welfare of his workers. He was instrumental in introducing what was then termed "district nursing," inasmuch as most residents of the surrounding Vermont villages were employees of his company. In those days minor injuries sustained at work were given scanty consideration; accordingly, Miss Stewart's duties consisted of home nursing of indisposed workers and their families. Included, also, was anyone in the vicinity who was unable to obtain medical attention because of adverse financial circumstances. Although a horse and buggy were at Miss Stewart's disposal, her choice of transportation frequently was a bicycle, much to the delight and amusement of her patients and their families.

A similar service was instituted in 1897 by the John Wanamaker Company in New York. However, their nurse, Anna B. Duncan, was quickly cognizant of the need for more than visiting nursing. In connection with her duties she recommended that slight injuries be attended immediately, sanitation observed, and undue hazards minimized. She maintained that the plant nurse should be well versed in these conditions, as well as in the unwritten factory safety laws. These views later became an integral part of industrial medicine.

Taking the lead among department stores in adding a nurse to their personnel was Frederick Loeser of Brooklyn in 1899. The early 1900's showed a sharp upward trend in industrial safety and hygiene. Among the companies staffing nurses were the Emporium, of San Francisco (1900), Anaconda Mining Company, Montana (1901), the Broadway Store, Los Angeles (1902), Chase Metal Works, of Connecticut (1902), Hale Bros., San Francisco (1903), Plymouth Cordage Company, in Massachusetts (1904), Filene's of Boston (1904), Carson, Pirie, Scott, in Chicago (1904), Fulton Cotton Mills, in Georgia (1905), and Bullock's, Los Angeles (1906).

Differing from the types of health programs established by the concerns mentioned was the experiment in home nursing offered by the Metropolitan Life Insurance Company in 1909. The holders of industrial policies in a part of Manhattan were given nursing care by visiting nurses, who reported their findings and care. These visits were paid for by the insurance company at the rate of 50 cents each. Response was so enthusiastic that this plan was adopted for metropolitan New York and later extended throughout the United States.

By 1914, three years after the first state workmen's compensation law became effective in Wisconsin, 60 firms offered nursing service. It was not until 1911 that a definite economic appraisal was made of bodily injury, disability or loss of time which befell the employee while at work. The main purpose of this was to pro-

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vide automatic and prompt financial relief to an injured worker at a time most needed. With the passage of this legislation, a new and fixed expense was created for industry. Consequently, accident prevention was rapidly inaugurated. In 1912, the National Safety Council was organized, which was to give strong support to the development of industrial nursing.

The need for industrial nurses seems to have fluctuated with the rise and fall of employment. In 1930, the first year of the depression, industry's payrolls revealed 3,189 trained nurses, referred to as such in early days of the profession but now commonly known as R.N.'s. The number slumped to 2,200 in 1937, a poor business year. Four years later, upon our entrance into a second world conflict, the demand nearly trebled, and in 1943 the number reached 12,838. This growth was promoted by gigantic industries such as shipbuilding, aircraft, and construction projects.

Implied in these statistics is the fact the establishment of an industrial nursing service is a sound financial investment. The plant nurse plays an important role in helping to achieve the major objectives recommended by authorities in industrial health and safety, namely, to ascertain by examination the mental and physical fitness of a new employee, to maintain and improve the health of those already employed, to educate the worker in accident prevention and personal hygiene, and to reduce lost time due to illness or injury. The functioning of such a program safeguards the worker against loss of wages and mental and physical anguish; the employer benefits by steadier production and reduced workmen's compensation insurance premiums. As an example, it is estimated that the U.S. Rubber Company, through its accident prevention program, has saved $50,000 a year in workmen's compensation premiums alone.

IF WE HAD television perception and could observe a nurse being initiated into an industrial plant, with for instance, 2000 employees, we would probably see her at a table filling out a lengthy application form. This completed, she is interviewed in turn by the employment supervisor and the Medical Director. This nurse has had three years' experience in general duty nursing. She appears to be intelligent, in good health, is comely, and radiates personality. These, among other attributes, constitute those desired of an industrial nursing candidate. Prevailing standards of the company relative to education, experience, specialization and other pertinent qualifications will determine her acceptability from that standpoint. But that is not all. She must also undergo, and pass, a thorough physical examination, which includes several exacting eye tests. Many workers' eyes have been saved by a nurse's keen visual acuity in detecting and removing minute foreign particles before these could cause permanent impairment of vision.

Having successfully passed her examination the nurse is returned to the personnel office and is shown where and how to punch a time-card, a deviation from her former routine. This procedure, unflattering as it may appear, discourages requests for overtime work without additional pay by the employer or unjustifiable tardiness or absenteeism on the part of the employee.

On the following day the nurse joins the thousands of others of her profession who have made industrial nursing their career. She reports to the supervising nurse, who briefs her on the work to be performed and the functions of the department. The scope of an industrial health unit is governed by the size of the business concern; its duties are usually varied and numerous. These include the care of emergencies both industrial and non-industrial, assisting the doctors with physical examinations, participating in health promotion, safety education and the improvement of environmental sanitation. It is important that the nurse have a knowledge of the state's workmen's compensation laws. Following this, accident frequency and severity rates are explained to her. The former is the number of disabling injuries per million man-hours worked; the latter is the number of man-days lost per thousand man-hours worked. A disabling injury is one arising out of and in the course of employment that results in loss of time beyond the shift on which the injury occurred, or causes permanent partial disability, permanent total disability, or death. The number of days lost is the actual number of days away from the job because of disabling injuries *plus* time charges. These are taken from a standard table recommended by the International Association of Industrial Accident Boards and Commissions. A fatality, for example, results in a charge of 6,000 man-days; the loss of a finger 300 man-days. A perfect score for frequency and severity contains only ciphers. Points not covered are discussed in detail in the procedure book which the new staff member is encouraged to read thoroughly before assuming her duties.

A plant tour embraces the remainder of the nurse's indoctrination. All medical members should know what is being manufactured, the various processes, machinery and materials used, the hazards accompanying these, and the control measures practiced. First is a quick trip to personnel, which reveals that this department in addition to its function of securing suitable employees has the task of sustaining satisfactory employee-management relations. The worker's personal problems, whether these be a needed loan from the credit union, the obtaining of living quarters, or the request to participate in recreational activities, are all handled here.

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Next is the general office, comprising accounting, purchasing, sales, engineering, planning, advertising, and top management. Here the newcomer catches a heart-warming glimpse of the general manager pinning a service award on the lapel of an employee who must have had not less than 10 years of service with the company to have been eligible. Similar awards are given for 15, 20, 25, and 30 years of service. The fact that such honors are bestowed on approximately 90 employees at this plant each year gives the new medical staff member a feeling of pride to be on a team which so remarkably exemplifies its spirit of good will.

In the machine shop the nursing supervisor and the new industrial nurse are joined by a production supervisor who explains some of the functional aspects of the countless machines. There are lathes, milling machines, shapers, planers, grinders, metal cutting saws, drill presses, and variations of each of these. This is confusing to begin with, but after a few months the nurse will be able to identify most of these machines and understand their operating principles and the hazards related to each.

The production supervisor reviews a few of the accidents which have occurred here from time to time. In the grinding room the lens of a worker's eye was penetrated by a foreign body, resulting in total blindness of that eye. Had safety glasses, furnished by the company, been worn this would not have happened. At the drill presses, operated mainly by women, it is pointed out that one feminine worker lost her cherished chignon and part of her scalp because she did not heed the company rule requiring women to wear protective caps at their machines. The welding department was the source of another casualty. Here one of the welders who neglected to wear his hood while making short arc welds received severe ultra-violet radiation burns of the eyes, necessitating extensive treatment and causing loss of time. Milling machines can also be dangerous. One machine in particular caused a man to lose an index finger when he attempted to remove chips with his hand instead of a brush. Repetition of similar accidents, of course, will be precluded to a large degree by preventive measures taken by the Medical and Safety Departments.

With this initial knowledge of plant operation the nurse returns to the Medical Department where she zestfully undertakes the bandaging of fingers and hands, gives infra-red treatments, dispenses medicine as ordered by the doctors, removes foreign bodies from the eyes of patients, assists in surgery if directed, and helps to complete medical records. There are also things that the nurse must not do, namely, diagnose cases, administer medications without a doctor's order, or release confidential information to those not authorized to receive it.

Currently there are 13,000 R.N.'s who are performing a commendable service in industry. But, in the words of Victor Hugo, "What is done is but little by the side of what remains to be done."

(2655 106th Avenue.)

## The Industrial Point of View

WE THINK of preventive medicine as something with which we can prevent or reduce pathology, morbidity or mortality. The modern industrial point of view is more inclusive—it is the prevention of loss. Because industry is beginning to appreciate that pathology, morbidity and mortality contribute to economic loss, we who are interested in preventive medicine have powerful allies among those who seek the primary ways and means of preventing loss.

—From "The Meeting-Place for Industrial Health," by DWIGHT O'HARA, M.D., F.A.C.P., in *Ann. Int. Med.*, 36:2, 565 (February) 1952.

# INDUSTRIAL MEDICAL ASSOCIATION

## The President's Page

A STUDY of the recent history of this Association will reveal even to the casually interested that it has become a powerful force in all matters related to occupational medicine in this country. This is at once an encouraging and a sobering conclusion: encouraging because it is good that occupational medicine should be in the hands of those who understand it, and sobering because of our acceptance of the principle that with power goes responsibility. This responsibility pertains to the relationships of the Association to the public as well as the relationships of the members to the Association. It is with the latter that we shall deal here.

A serious effort has been made during the past year to gain the participation of the greatest possible number of members in the affairs of the Association. The major areas of interest of the President were delegated to the President-Elect, and to the First and Second Vice-Presidents. In practice these officers became executive vice-presidents who are respectively responsible for the activities of the District Counselors and component societies, the standing committees, and the President's administrative interests in the American Foundation of Occupational Health. These Officers and the Association's Secretary and Managing Director have served in fact as well as in name as the Association's Executive Committee. The policies to be inherited by the next Executive Committee will be those which five of its six members have helped form.

The ultimate responsibility for policy formation rests with the Association's Board of Directors. No practical way exists for keeping the Directors abreast of the running discussions which provide the background for the best decisions. This lack has been overcome in considerable part by limiting the topics of a Directors' meeting to those on a prepared agenda which is strictly observed, and by supplying the Directors well in advance of a meeting with copies of the reports and correspondence that illuminate all sides of the questions to be considered. The meetings of the Board of Directors are perhaps the most important forums on the affairs of occupational medicine. In recognition of this, the by-laws were changed a year ago to ensure that Directors continue to be carefully selected. It is the responsibility of each member of the Association who is present at the Annual Meeting to become informed of the qualifications of the candidates who have been nominated for Directors' positions, and by written ballot help choose Directors most able to guide the Association's affairs.

The responsibilities of the District Counselors have recently been described in some detail. Great reliance is placed on them for promoting occupational medicine in their respective districts through the machinery of the Association. The Counselors have the further responsibility of being sensitive to opinions held by members on matters of importance to our special field of practice, and to see that these opinions are made known to the Association's Directors and Officers.

A great deal of serious thought and discussion went into the appointment of committees this year. All selections were made with the approval of the Association's Officers. The functions of the committees were defined. As evidence that the distribution of committee interests is reasonably adequate it can be reported that no *ad hoc* committee has been appointed during the year. It has been possible to submit all of the questions requiring group consideration to experienced standing committees.

A problem which is central to the continued vigor and effectiveness of the Association is that of maintaining energetic mobility while retaining democratic methods of operation. Important steps toward democratization were taken with the revision last year of the by-laws governing the election of Directors and Officers. More was accomplished along the same line throughout this year by a spreading of administrative responsibilities. It is estimated that the number of persons intimately acquainted with the Association's business and actively participating in its administration was increased tenfold. A faster spread of responsibility than this would probably have proved administratively unhealthy.

This brings to a close the present series of the President's Page. The Page was brought into being at the suggestion of DR. E. A. IRVIN on the occasion of an informal conference of the Association's new officers in Atlantic City last April. In his capable hands now rests the pleasant chore of continuing what was hopefully launched as a useful activity of the President's office. That it has proved to be useful is suggested by the favorable and encouraging comments received with gratifying frequency from a wide circle of colleagues. Much help was received from friends who supplied information and reviewed copy for accuracy. We close on a final note of gratitude to them as well as to the publisher and editor of *Industrial Medicine and Surgery* for their willingness cheerfully to meet all demands however unreasonable for the sake of providing service to the Association.

A. J. Kammer

# 1952 Industrial Health Conference - Cincinnati

FEATURES of the INDUSTRIAL HEALTH CONFERENCE at Cincinnati, April 19-27, will be the IMA Hospital Clinics at the Cincinnati General Hospital. These begin at 9:00 A.M., Monday, April 21. At the Dermatology Clinic DR. R. R. SUSKIND and staff will have the subject, "Current Problems in Occupational Dermatoses." This will be held in the Lecture Room, Kettering Laboratory. The Surgical Clinics, beginning at the same time in the Surgical Amphitheatre will have the subjects, "Hand Injuries," by DR. VINTON E. SILER, and "Fractures" by DR. EDGAR H. WHITE. The Tuesday Clinics, also beginning at 9:00 A.M. will be held in Room 22, Mont Reid Pavilion. They will include "Peptic Ulcer" by DR. W. DONALD ROSS; "Anemia" by DR. RICHARD W. VILTER; and "Hypertension" by DR. ALBERT A. BRUST, JR. The Surgical Clinics in the Surgical Amphitheatre will include "Head Injuries" by DR. JOSEPH P. EVANS; "Minor Wounds" by DR. JEAN M. STEVENSON; and "Injuries to Blood Vessels" by DR. L. G. HERRMANN.

A. G. Kammer
President
I.M.A.

E. A. Irvin
President-Elect
I.M.A.

An interpolated feature at 8:00 P.M., Monday, April 21 will be a Symposium on the "Importance of Job Security in Human Relations." DR. JOHN L. NORRIS, Chairman, IMA Committee on Human Relations, will be Moderator, and DR. WILLIAM E. BLATZ, University of Toronto, will present a formal paper.

CINCINNATI is considered a good convention city. It is "an important center of commerce and industry, and is pre-eminent as a location of medical education and research. It is, moreover, the location of world famous Kettering Laboratory of Applied Physiology and of the Environmental Health Center of the U.S. Public Health Service. Other attractions are a reasonable hope for traditionally gentle spring weather during the third week of April, and a convention hotel which is one of the country's most beautiful. The event will mark the tenth anniversary of the Association's previous convention in Cincinnati. Those who were there 10 years ago will recall the growing awareness of the essentiality of industrial medicine to a successful prosecution of the war, and the emergence of a concept, however slow to crystallize, that ours was a special field of practice attuned to, and designed to deal with, a large and important share of the human problems of our day. Those who are present this time will witness the measure of reality to which the concept has been brought in a decade."

## Plant Tours

FIELD TRIPS in chartered buses are scheduled to leave from the Netherland Plaza Hotel at 1:30 on the afternoon of Monday, April 21. Each tour will last approximately three hours, including travel time from the hotel and return. Only one of the designated trips can be taken. The cost of transportation will be 50c to 75c per person, for which tickets will be provided for those who register in advance. Those wishing to take one of the trips, should register by writing the chairman, DR. ERWIN C. BINSTADT, Cincinnati Milling Machine Company, Marburg Avenue, Cincinnati 9. Every effort will be made to provide for those who do not register in advance, but in view of the uncertainty of obtaining buses on short notice, advance registration provides the only means of assured transportation. The trips scheduled are as follows:

Anna M. Baetjer
President
A.I.H.A.

H. H. Dougherty
President
A.A.I.D.

Thelma M. Durham
President
A.A.I.N.

L. M. Petrie
President
A.C.G.I.H.

1. Allis-Chalmers Manufacturing Company
2. Cincinnati Milling Machine Company
3. Hilton-Davis Chemical Company (Number limited to 30)
4. The Kettering Laboratory
5. National Distillers Products Corporation (Number limited to 75)
6. Proctor and Gamble Company
7. U.S. Public Health Service, Division of Occupational Health Laboratories
8. Sight-seeing tour of Cincinnati

A special trip may be made to The Aircraft Gas Turbine Division of The General Electric Company by arrangement made three weeks in advance (for reasons of security). Send advance registration request to DR. BINSTADT immediately. *Birth certificate or other proof of security clearance necessary.*

## The Exhibitors and Their Exhibits

THE EXHIBITORS and the general character of their displays are indicated in the following list. Here again is the latest in "Product Research and Development" of interest to everyone in the industrial medical field and in all its related activities.

*American Cancer Society.*

*American Optical Company*—"Industrial Safety and Visual Efficiency".....Booth 31.

*Americana Corporation*—"Displaying the Mid-Century Printing of the Encyclopedia Americana".....Booth 59.

*Americaine, Inc.*—"New Preparations for More Potent Control of Topical Pain and Itching".....Booth 62.

*Armour and Company*—"Featuring the Dial Line of Antiseptic Soaps".....Booth 66.

*Armour Laboratories*—"Endocrine Products, Including Acthar (Acth)".....Booth 20.

*A. S. Aloe Company*—"Physicians, Hospital and Laboratory Equipment and Supplies".....Booths 11 and 12.

*Audiometer Sales Corporation*—"Displaying the Model 53A-ADC Audiometer and Other Models".....Booth 30.

*Bauer and Black*—"Featuring Complete Line of Hospital Surgical Dressings"....Booth 63.

*Bausch and Lomb Optical Company*—"Demonstration of the Ortho-Rater and Information about Bausch and Lomb Industrial Vision Service".....Booth 21.

*Becton, Dickinson and Company*—"Exhibiting Line of Vacutainers, Culture Bottles and Dynafit Syringes".....Booth 49.

*Becton, Dickinson and Company*—"Featuring Ace Elastic Bandages, Cotton and Rubber Re-inforced .....Booth "D".

*Breck, John H., Inc.*—"Featuring Its Line of Industrial Preparations Designed to Aid in the Prevention of Industrial Dermatitis" .....Booth 41.

*Bristol-Myers Company*—"Bufferin, Ammens Powder, Sal Hepatica and Other Famous Products" .....Booth 14 and 15.

*Bristol-Myers and Company*—"Free Visual Units on Dental Health, Body Cleanliness, and Hand Care".....Booth 10.

*Burt, Leslie R.*—"Molecular Equipment to the Bacteriological Analysis of Water and Air" .....Booth "J".

*Campbell Associates*—"Complete line of Surgical Instruments, First-aid Supplies, Diathermy" .....Booth "G".

*Camel Cigarettes*—"Color Slides of Background Data from Research".....Booths 16 and 17.

*Carbisulphoil Company*—"Foille Emulsion; Foille Ointment; Activol Liquid Soap; Tarcaine" .....Booth 34.

*Chattanooga Pharmacal Company, Inc.*—"Hydrocollator Master Units and Hydrocollator Steam Packs" .....Booth "I".

*Chesebrough Manufacturing Company*—"'Vaseline' Sterile Petrolatum Gauze Dressings" .....Booth 4.

*Ciba Pharmaceutical Products, Inc.*—"Featuring Elkosin, a New Sulfonamide".Booth 52.

*Coca-Cola Company*—"Ice-cold Coca-Cola (Served through the Courtesy and Cooperation of the Coca-Cola Bottling Company .....Booth 33.

*Crocker-Fels Company*—"Medical and Surgical Supplies for Use in Industrial Hospitals and First-Aid Departments"...Booth 1.

*Davis Emergency Equipment Company, Inc.*—"Portable Instruments for Analysis of Toxic Gases and Respiratory Protective Equipment" .....Booth 19.

*Davis and Geck, Inc.*—"Comprehensive Line of Surgical Sutures and Other Surgical Specialties" .....Booth 26.

*Denver Chemical Manufacturing Company, Inc.*—"Galatest, Acetone Test, Antiphlogistine Poultice, Antiphlogistine Rube A 535" .....Booth 25.

*Desitin Chemical Company*—"Desitin Products" .....Booth 36.

*Doho Chemical Corporation*—"Announcing the New Nasal Decongestant—Rhinalgan" .....Booth 37.

*Dome Chemicals, Inc.*—"Makers of Distinctive Dermatologicals" .....Booth 45.

*Duke Laboratories*—"Aolan-Aquaphor-Basis Soap; Elastoplast-Gelocast-Mediplasti-Nivea Products; Tecto" .....Booth 54.

*Eaton Laboratories*—"Products of Special Interest to Industrial Physicians"...Booth 57.

*E. Fougera and Company*—"Efocaine, the New Depot Solution for Prolonged Anesthesia" .....Booth 43.

*Hillman Pharmaceutical Company*—"Hillman's D Compound" .....Booth 40.

*Hygiene Research, Inc.*—"Pharmaceutical Supplies, Verex Protective Cream"...Booth 32.

*Ille Electric Corporation*—"Physical Therapy Equipment" .....Booth 74.

*International Cellucotton Products Company*—"Printed Educational Materials on Health; Information for Girls and Young Women" .....Booth 56.

*Johnson & Johnson*—"Surgical Dressings" .....Booth 71.

*Keystone View Company*—"Vision Screening and Still Projection Equipment" .....Booth 67.

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*Lambert Research Lab., Inc.*—"Lambert's C-T-A Surgical Dressing".....Booth "E".

*Liberty Mutual Insurance Company*—"A New Approach to Industrial Disability" .....Booth 75.

*Liebel-Flarsheim Company*—"Diathermy and Electrosurgical Equipment" .....Booth 44.

*Eli Lilly and Company*—"Demonstration of Functional Packaging as an Aid to Medical Practice" .....Booth 3.

*Maico Company, Inc.*—"Displaying Several Models of Audiometers Recommended in Industrial Hearing Programs".....Booth 38.

*Manhattan Uniform Company*—"Doctors' and Nurses' Professional Uniforms and Operating Room Uniforms".....Booth 53.

*Max Wocher and Son Company*—"Surgical, Scientific and Medical Equipment, Instruments and Surgical Supplies"....Booth 55.

*Medco Products Company*—"Medcotronic Stimulator, Low-Volt Generator"....Booth 58.

*Metropolitan Life Insurance Company*—"Industrial Medicine and Safety Service of the Metropolitan Life".....Booth 23.

*Milburn Company*—"Skin Protection and Plastic Clothing".....Booth 8.

*Mine Safety Appliances Company*—"Instruments; Artificial Respiration Equipment; First Aid Materials" .....Booths 46 and 47.

*New York Medical Exchange*—"Medical Personnel Bureau" .....Booth "B".

*Nursing World*—"Only Nursing Journal to Carry a Separate Section on Industrial Nursing" .....Booth 61.

*Packwood, G. H., Manufacturing Company*—"Safety Industrial Skin Cleansers and Dispensers" .....Booth 51.

*Parke, Davis and Company*—"Pharmaceuticals and Biologicals" .....Booth 5.

*Philip Morris and Company, Ltd.*—"Results of Research on the Irritant Effects of Cigarette Smoke" .....Booth 22.

*Picker X-Ray Corporation*—"Latest Accessories and Equipment for X-Ray Work" .....Booths 72 and 73.

*Ries Corporation*—"Moistaire; Heat Therapy Equipment" .....Booth 27.

*Rystan Company, Inc.*—"Chloresium Ointment, Chloresium Solution Plain, Chloresium Powder" .....Booth 7.

*Sanborn Company*—"Electrocardiographs and Metabolism Tester".....Booth 35.

*Schenley Laboratories, Inc.*—"Titralac, a New Antacid Product".....Booth 9.

*Schering Corporation*—"Sodium Solution 30% Trimeton Maleate Lotion and Cream" .....Booth 50.

*Scholl Manufacturing Company*—"Double-Seal Adhesives and Dressings".....Booth 28.

*Scott Aviation Corporation*—"Scott Oxygen Demand Inhalator".....Booth 60.

*Sharp and Dome, Inc.*—"Pharmaceuticals and Biologicals; Clinical Data from the Laboratories of the Medical Research Division" .....Booth 13.

*Squibb, E. R., and Sons*—"Pharmaceuticals" .....Booth 6.

*Stepan Chemical Company*—"ph 6 Skin Cleanser" .....Booth 79.

*Stephenson Corporation*—"Respiration and Scientific Equipment".....Booth "A".

*Sugar Beet Products Company*—"Industrial Soaps, Cleaners, and Dispensing Equipment" .....Booth 69.

*Tampax Incorporated*—"Educational Material on Menstruation".....Booth 18.

*Tarbonis Company*—"Tarbonis Cream, Histar Cream" .....Booth 29.

*Teckla Garment Company*—"Gowns, Blouses, and Kimonas" .....Booth "C".

*Travenol Laboratories, Inc.*—"Featuring Pyromen" .....Booth 70.

*Truform Anatomical Supports*—"Comprehensive Series of Back-Supporting Garments and Braces" .....Booth 42.

*United States Safety Service Company*—"The Latest Developments in Salt Tablets" .....Booth 24.

*United States Tobacco Company*—"Sano Cigarettes" .....Booth 64.

*Walden Industries, Inc.*—"Clinical Photographic Outfits" .....Booth 65.

*Westwood Pharmaceutical Company*—"Featuring New Improved Lowila Cake" Booth "H".

*Williams, The J. B. Company*—"New Product of Interest to Industrial Physicians, Nurses, Hygienists" .....Booth 68.

*Wilson Products, Inc.*—"Impinger Units, Hydrocarbon Sampling Apparatus, Thermo-Aneometer, Respirators, Gas-Masks, etc." .....Booth 2.

*Winthrop-Stearns*—"Featuring pHisohex, pHisoderm, Zephiran Chloride".....Booth 48.

## SCIENCE MINIATURE

### Industrial Iron Sulphate Poisoning

CAREY P. McCORD, M.D.

ON MARCH 10, 1950, at a paint plant, five workmen were going about their customary duties of unloading coating materials from box cars. On this day the task was the unloading of bagged red oxide of iron, a task with many years of precedents. Near noon two of the five became acutely and severely ill. By self diagnosis, they ascribed their illness to food although each consumed different brought lunches. These two were not observed medically. Shortly after noon two other workmen became similarly ill, one severely. When first seen, the severely ill one was found with head hanging over a toilet seat, in collapse, vomiting, nauseated, dizzy, pale, almost pulseless, dehydrated, and complaining of abdominal pain. The less acutely ill workman complained of minor nausea and weakness.

Rightly the iron oxide, of which little was in

evidence, was not suspected. It was then reported that the box car floor, walls, and ceiling were richly coated with accumulations of a greenish-white powder that provided some dustiness in the process of car unloading. Hastily this was analyzed and proved to be ferrous sulphate with some ferric sulphate and possibly some minor impurities. Later it was established that the iron oxide produced at a distant plant derived from the roasting of commercial sulphate. Apparently a bulk car lot of the sulphate had been unloaded at the producing plant and reloaded with bagged red oxide without any car cleaning. Thus the source of the sulphate was determined.

Since the clinical picture precisely was that associated with massive intake of inorganic iron salts including the chloride and sulphate, it was inferred that the sulphate(s) was the offending agent. But the situation was complex. It is well known that in past decades more than now, iron salts widely have been administered medically in sizable doses without the building up of reputation for frequent bodily disturbances save from massive doses. In industry, iron sulphates long have been freely manipulated without any widespread recognition as to harmful properties. The surmise is that whereas oral intake of these sulphates leads only to trivial absorption from the intestinal tract, inhalation intake in the form of dust may be more significant. In the present instance it may not be believed that ingestion from food contamination or from swallowed saliva may have been sufficient to reach the "massive" dosage known to medicine. At least some dust inhalation may have occurred.

Without drawing any conclusion it is merely reported that four of five workmen exposed to substantial quantities of iron sulphates became acutely and seriously (three) ill. This illness persisted only about 24 hours. Adhering to the well accepted concept that an occupational disease requires exposure longer than one work day, this episode is to be catalogued as an "accidental" event.

## BOOKS

### Organic Chemistry

ORGANIC CHEMISTRY: J. P. WIBAUT, Professor of Organic Chemistry: The Elsevier Press, 402 Lovett Boulevard, Houston, Texas, 1951, pp. 626, $9.00.

THE industrial physician in any manufacturing establishment might as well accept the fact that he is more valuable if he knows more chemistry than provided by his student training, and notably the chemistry of his immediate industry. It is well and good to know much about such things as pernicious anemia and tenosynovitis, but that is not enough. Chiefly occupational diseases spring from chemicals. Every industry employs chemicals—some by the thousands. When the plant chemist or industrial hygienist or works manager talks glibly about "aliphatic compounds" or perchance "polyaldehydes" the physician is likely to present an "in absentia" look and he begins to wish he had specialized in obstetrics. The up-and-coming industrial physician is not content merely to brood in his ignorance. He sets about the acquisition of his plant's chemistry. Never is the intent to transform the physician into a first-rate chemist, or even a third-rate one, but "on the spot" chemistry is essential.

For all aspiring industrial physicians, here is the background of chemical lore—at least as far as organic chemistry is concerned. It is the great face saver, dispelling that "in absentia" demeanor.

A statement on the jacket introduces the purpose. It runs: "A textbook intended not only for students, who have chosen chemistry as their main subject, but also for students of medicine and biology, and all those who may desire to obtain in a straightforward way an insight into the structure of the substances with which they come into contact in connection with their vocation."

No industrial physician ever will acquire full familiarity with every section of this book. That is not requisite, but if only once, monthly, it prepares the physician to talk impressively with his plant peers about the plant's chemicals and their potential exposures, then this book becomes an asset. My copy already has become a valued asset.

### The Vulnerable Hospital

LAW OF HOSPITAL, PHYSICIAN, AND PATIENT: EMANUEL HAYT, LL.B.; LILLIAN R. HAYT, M.A., J.D.; AUGUST H. GROESCHEL, A.B., M.D., M.S. Second Edition, Prepared in collaboration with the American College of Hospital Administrators. Hospital Textbook Company, New York City, 1952, pp. 804.

IN THE ideal state there would be no laws—no need for police, no enforcement—merely universal adherence and compliance with the customs of the community, by a well-disciplined and well-informed population. There is no ideal state, and there never will be. Even in a less developed state it might appear that so beneficent an agency as a hospital in its affairs of life saving, pain removing, and health restoration, would be accorded some degree of unassailability by laws and regulations. Such is not the case and maybe should not be. Just the opposite is true. The hospital is outstandingly vulnerable to legal besetments.

A large hospital is one of the most complex of all man's creations. Compared in terms of legal vulnerability, any large hospital is scores of times more complex than a department store of equal size and an equal number of participants. A hospital is serviced by administrators, clerks, physicians, nurses, interns, residents, laboratory workers, technicians, sometimes by medical and nursing students, anesthetists, consultants, visiting physicians who may bring in their own private assistants and anesthetists, ambulance drivers, orderlies, and the necessary array of maintenance forces. The hospital's jeopardy is influenced by the deranged patient, the alcoholic patient, the patient with communicable disease, the thieving patient or employee. Any and all may commit acts or fail to commit acts detrimental to one or other persons—all in endless variation.

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Hospitals have their legal responsibilities and recognize their obligations. Hospitals have their defenses when defense is in order, and thank God and man for laudable defenses. But the mere existence of responsibilities and defenses fails to make everything simple. Situations without precedent are countless. Shades of difference everywhere arise. Here are some of the elmentary problems: who is responsible, and how much, when a medical student assigned to a tuberculosis ward acquires that infection? What is the legal consequence when a suddenly-acquired mania in a patient leads to his jumping from a seventh-story window? A surgeon with hospital privileges, but unpaid by the hospital, brings in his own anesthetist. Disaster arises. Is the hospital legally culpable? The x-ray department, without any evil intent and without calculable neglect, burns a patient. Where lies the legal onus? By mishap, two bodies are mixed as to identity. The wrong body is shipped away by the innocent undertaker. Who is to blame? Multiply by a thousand, then add another thousand. Just what is the average length of life of a hospital superintendent anyway?

The authors of this book, armed with experience, precedent, the laws, without prejudice as to patient, physician, management or anybody, face all these dilemmas. They do not make everything simple. Nobody could. They provide facts, guidance, anticipatable pitfalls, procedures, commendable behavior. They indicate when defense is in order, and what defense. They stand by the hospital, the patient, the physician, the nurse, the intern—when their acts merit support. Always they maintain that the most secure position lies with all who know the law and responsibilities and live within these legal and human impositions.

To attempt to provide in any review extensive details as to contents would but affront the vastness of this book's coverage. Better it is only to present its flavor, its intent, its command to get and read and rely. Industrial dispensaries and physicians enjoy no happy life beyond laws and legal onslaughts. This book has its place in industrial medicine. The reviewer joins the authors in the realization that the next legally troublesome situation in your professional life, may appear to be strange and unheard of. Even so there may be laws, lawyers, and, somewhere down the line, a decision. That decision should be just.

## Added Meaning to the Added Years

MAN AND HIS YEARS: Federal Security Agency. Health Publications Institute, Inc., Raleigh, North Carolina, 1951, pp. 311.

THIS volume is an objective account of the first National Conference on Aging. It represents the best American thinking, so far, on the implications of the remarkable shift in age groups in our population. It reflects a striking unanimity of opinion on the need for far-reaching adjustments in our attitudes and behavior to keep pace with this shift. And it suggests ways of satisfying this need.

The Conference was called because the American people are growing up, in the most literal sense. The average age level is rising steadily, and the proportion of older people is increasing with equal constancy. Inevitably, the question has arisen: What shall we do about our old people? Shall we ignore them and dissipate the most mature years of their lives, so that they become meaningless as people and as part of our national community? Or shall we look upon their experience, skills, wisdom, and judgment as great national assets which, if properly utilized, could serve the country well while giving added meaning to their added years?

Partly, of course, the answer must lie with the old people themselves. But even this statement implies that in larger part the answer lies with every one of us—for, whatever our years, each person expects to live to the years of maturity, and what we do about our older citizens affects our own lives now and later.

"Many centuries ago, in an earlier era, children from all over Europe joined in the dramatic, heart-rending, and yet somehow ennobling Children's Crusade. Today we need to unite with our older citizens in a new kind of crusade—a crusade that will fit older people into the local community and into the larger community we call the United States of America. We need to do this for self-preservation; but, in a larger sense, we need to do this out of fairness to the older people themselves. Having made life longer, we must now work to make longer life worth while."

And so this book. Those quotation marks say "Federal Security Administration is credited with being the chapter's author." If that be accepted as a warning, the legal department will have deleted, prior to publication, any implied *"lese majesty."*

## Chemistry

MEDICINAL CHEMISTRY: Volume II. by ALFRED BURGER, Associate Professor of Chemistry, University of Virginia. Interscience Publishers, Inc., New York, 1951, pp. 1084, $10.00.

ONLY recently in these pages appeared a review of Volume I of this series, and not without praise. Therein was forecast the early appearance of Volume II. Here it is, and good. As to be expected, Volume II requires none of the stage-setting requisite to the introduction of the first volume. The author leaps into his meaty presentations. In his preface Dr. Burger implies that he has leaned heavily upon current literature. This he has and right up through July, 1951, but this is no staid assemblage of abstracts. Dr. Burger with his own active editorial enzymes has digested and appraised the publications of others. The result is ready for assimilation and application. Only by mention of some chapter headings may the range of coverage be revealed to the reader: The Hormones; Essential Amino Acids and Fatty Acids; Chemotherapy; Theories of Metabolite Antagonism; Dyestuffs in Chemotherapy; The Sulfonamide Drugs; Antimalarials; Chemotherapy of Acid-Fast Infections; Metal-Free Drugs Used in Tropical Diseases; Antibiotics; Antifungal Agents; Anthelmintics; Organometallic Chemotherapeutic Compounds of Arsenic, Antimony and Bismuth; Sterilization and Disinfection; Antiseptics.

Hardly any physician other than Dr. Burger can know all that these two volumes afford; however, even small portions of this lore will make physicians better physicians. P.S. This includes industrial physicians.

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# INDUSTRIAL MEDICINE AND SURGERY

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## The Distaff Industrial Workers

SO FAR removed is the nation from the practices that gave rise to the term "distaff" for women's work that few will grasp its significance.

In the days of our great grandmothers, when the economy of the United States was largely agricultural, families were isolated and more or less self-supporting units. The mother of the family made her contribution in terms of services. She taught her children, nursed the sick, wove the cloth, made clothes, soap and candles, and even planned the social life for the family. As the scene shifted and our economy became industrialized, with concentrations of population in urban centers, the woman's contribution to her family also changed. Many of the services she performed are now available through the community, such as the public schools, and hospitals. It is cheaper to buy materials than to weave them; the important contribution to the family now is money income to purchase goods and services.

This shift in the pattern or locus of woman's work has introduced 20 million of them into the nation's labor. Near to 55% are married, an innovation in itself. Another 16% are divorced or widowed. The remaining 29% of unmarried ones often are still responsible for household affairs added to the daily job. This double work confronts about 65% of all distaff producers.

Just where does this 31% of the total work army find employment? Five million carry on duties in offices—even so, at present there exists a shortage. Three and a half million are factory workers. Textiles, shoes, tobacco claim the larger numbers. Third, come those two million serving as cooks, waitresses, beauty-parlor operators, but not including those in domestic service.

A fourth category of two million (nearly) is filled by the professional woman; the teacher, the nurse, the physician, the lawyer. Far down the listing comes the "domestic." That work has lost its lure. Too, the housewife has just about been priced out of the luxury of servants. The gap up to the 20 million mostly is filled with saleswomen, managers, office holders, military personnel and, inevitably, the "miscellaneous."

These are the unadorned facts as to numbers of women in industry without signal prospect of marked shiftings, come war or peace. The figures are presented with a direct intent. In all plannings for occupation health programs, personnel, facilities and benefits, 20 million women workers are not to be overlooked.

## The Oldest Profession

IN OFF-STAGE ribald banter, the accolade of the pristine, long has been handed to the harlot as protagonist of the earliest occupation. Far behind that time when the Phoenicians discovered money as a convenient substitute for mere barter, the strumpet was unhandicapped in the purveyal of her wares. Nor does history record any indications that she was lacking in patronage. Veraciously it may come about that that which was acceptable as "sound money" often was established by what she would accept in return for her favors. When the Spanish conquistadores had their bate of looting Mexico, they moved eastward for similar depravities of Yucatan. There, to their astonishment, cocoa beans were the coin of the realm. Incredulously

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they set about the supreme test. Cocoa beans were offered the frail sisterhood of the back streets. It worked. So, the monetary system was rated sound—but perhaps little acceptable at the throne of the king and queen of Spain.

In any language, the more indelicate the matter to be termed, the greater the variety of names called upon to convey the indelicacy. The plyers of this ancient profession of harlotry have been accorded a greater number of dictionary-acceptable names than perhaps any other: discretion hiding behind diluted semantics. Gallantly, the English language, not to be outdone, has made its contributions, in creation or in acceptance, in "wanton, adulteress, courtesan, prostitute, broad, chippy, street-walker, goddess of liberty, whore, tart, wench, trollop, hussy, jade, concubine, harridan"—just to mention the politer ones. This very multiplicity of names betokens a long reach into the past. As to this profession, the ancientness is beyond debate. The only point to be tossed about upon the fingertips is the "most ancient." But:

The first segregation of any tribal activities led to the medicine man—half priest, half the progenitor of the physician. Long before primitive man became a hunter or a soil tiller, he joined in the common pursuit of seeking to survive. He was unwittingly a "jack of all trades" before any trades existed. Beset by all manner of threats—from beasts, elements, floods, fire, diseases—his fears directed him to seek solace and protection. This quest created the medicine man and priest. This first professional man early grasped the significance and power of portents, omens, rites, mystery. He wrestled in behalf of his fellows with demons, devils, evil spirits, and witches—all of which he conveniently created. He made no attempt to separate his function as priest from his role of physician. The two were one and inseparable, just as these two functions today, though little discernedly, are intertwined.

Wherever man, however far apart and without knowledge or communication, has banded into groups under any name, the first organized setting apart of activities has been the shaman, which term connotes the dual service of priest and physician. He was the product of fear and dread—the designated tribal protector against the unknown—and most everything in primitive life was unknown or uncertain.

Every physician of today is the professional descendant of the oldest profession. In his instance, both "ancient and honorable" are applicable. Possibly the modern practitioner should be thankful that he hasn't the occupational hazard of his remote prototypes. They often had their heads cut off when their cures didn't cure . . . .

## The Male Housewife

MANY another industrial physician, especially the consultant in the field, takes some pride in the numbers of trades with which he is familiar. One may mention 1,000, another 4,000 – both small on reference to the total of about 30,000 forms of livelihood. Whenever any vaunting appears, some perky housewife may do a little twitting: "But, you don't know anything about the industry of being a housewife." One abashed industrial physician, thus duly humiliated, sought to remedy this defection in his familiarity with occupational ramifications. Living alone, by careful design he procured a modern furnished house, complete with kitchen, incinerator, laundry, fireplaces, vacuum cleaners, household chemicals, and all the other dreadful appurtenances euphemistically referred to as conveniences. Fortunately, there was no screaming offspring, nor any complaining spouse. In keeping with the lot of the average female housewife, no effort was made to secure the help of any maid, cook, scrubwoman, or other assistance. This was no temporary period of bachelor "roughing it," but a well-resolved effort to maintain a large and orderly household made complex by numerous dinners and parties, all requiring endless buying. Since a full complement of the usual day-by-day work at the office was required, a concession was accepted—no laundry work.

Now that his hands are removed from the bandages necessitated by early injudicious encounters with hot grease, the humbled, but now well-informed, male housewife hastens to confess:

Housewifery is an industry—a hazardous one. If the same activities were carried out in manufacturing industry, long instruction would be provided; safety supervision would be deemed requisite; safety equipment would be supplied, including asbestos gloves and goggles; warning posters would fill the walls; absentee rates would be high, and labor turnover excessive.

The housewife lives in a world of fire and steam, chemicals and detergents, slips and falls, fatigue and exhaustion. Just let any novice attempt to slice a big, slippery, misshapen sweet potato, or peer incautiously into the oven when something steamy is cooking, or do a little household quick cleaning with carbon tetrachloride . . . . Learning comes fast, but painfully.

It's a good thing real housewifery is involved in love, devotion, marriage, personal loyalties—otherwise, there would be no housewifery.

This foolhardy, curious, industrial physician now has extended his personal touch from 4,000 to 4,001 occupations—but, at what a price!! The learning has been prodigious.

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# NEWS, COMMENT, OPINION

FOLKS nowadays are showing increased interest in their health and care of their bodies," the *Chicago Tribune* concluded as it reported a record 127,301 letters received during 1951 by DR. THEODORE VAN DELLEN, Editor of the *Tribune's* "How to Keep Well" Column. With the help of five assistants, three of whom devote their full time to correspondence, the *Tribune's* Medical Director answered an average of 490 inquiries each working day in the year—an increase of 20% over 1950. Of this total, some 100 letters daily—more than 26,000—required personal replies. If the inquiry could be answered by leaflet alone, the appropriate information was selected from files covering more than 300 subjects. Only letters which were accompanied by self-addressed, stamped envelopes were answered.

### The Whistler

A STUDY by the Institute of Social Research, University of Michigan, concludes that the man who whistles—or sings—at his work usually produces less than the one who gripes. The latter may denounce his job and boss, yet work harder than the singer and whistler. One researcher said: "It may be, that instead of firing the man who threatened to punch his boss in the nose, we should promote him."

—ALBERT EDWARD WIGGAM, D.Sc., in "Let's Explore Your Mind," *Chicago Daily News*, January 30, 1952.

### Two Highballs

ALCOHOL, taken in moderation (2½ oz. of whiskey or two highballs per 150-pound man), is highly useful in treating angina pectoris, diseases of the arteries in the extremities, etc. Recent work points out its possible use in delaying the onset of arteriosclerosis. It is contra-indicated in peptic ulcer patients. In angina, many doctors advise it to be taken before any expected strain or excitement. It acts as a sedative, therefore lessens anxiety and acts indirectly to overcome vasospasm both in the heart and peripherally, thereby reducing the load on the heart. When taken in excess (drunkenness) it has an unfavorable result, producing neurocirculatory asthenias, tachycardias, pulse irregularities, and aggravation of the angina.

—Abstr. in "Medicine in the News," of "Facts About Alcohol and Arteries," by GLEN R. SHEPHARD, M.D., in *Your Health*, Winter, 1952.

### Two Hangovers

A RECENT study by DR. THERON RANDOLPH, one of several eminent specialists speaking at the current congress of the International Association of Allergists in Zurich, Switzerland, embodies for both the confirmed drinker and the "one-or-two-snifters" man this warning: Don't drink beer if you are allergic to barley; don't drink wine if you are allergic to grapes; don't, in fact, drink anything if you are allergic to the grain, fruit or cereal from which it

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derives. To do so, says DR. RANDOLPH, will be to precipitate promptly and in intensive form the old allergy symptoms. Moreover, if such drinking continues, the imbiber will suffer two different but coalescing hangovers—the usual one from alcohol itself, and a second from the allergy involved.

—*North Carolina Med. J.*, January, 1952.

### Worry Room

A ST. LOUIS firm has installed a "worry room" in its offices. In this sanctuary, workers may work out problems away from the jangling phone and general office hubbub. The room contains comfortable chairs and a drawing board for engineers. Any employee may use it, the only rule being that of unbroken silence. The company's president considers the innovation a great success. He commented that feminine employees rarely used the room: "Girls don't seem to worry."

—*Convoys*, quoted in *Management Review*, January, 1952.

### The Oldest Profession

AFTER digging into the social customs of 250 or more tribes scattered around the world, Anthropologist George Peter Murdock, of Yale, has concluded that prostitution is not the world's oldest profession. Psychiatry is. Professor Murdock began by noting that prostitution (as distinct from mere laxity in sexual behavior) does not exist in any primitive society even today, but that the medicine man is universal. And the medicine man in aboriginal cultures is always a magician who practices faith healing. Though he may belong to a tribe skilled in the use of drugs like quinine, he usually leaves the practice of physical medicine to old men or women who become specialists as herbalists or bonesetters. The true medicine man, says Murdock, confines his practice to curing the ills of the mind. And surprisingly often, he succeeds. Psychoanalysis, Murdock finds, has much in common with primitive magic. From this, Murdock considers it a short, logical step "to regard the medicine man as the lineal ancestor not of the physician but of the psychiatrist." Modern sophisticates who speak jokingly of their psychoanalysts as "witch doctors" are closer to the mark than they think.

—*Time*, February 11, 1952.

### Physiques

STOCKY, muscular college students are likely to succeed in engineering; portly young men with substandard muscles are better off in the law. These are conclusions of FREDERICK L. STAGG, Harvard Research Fellow in Physical Anthropology, who specializes in human bodies and their effects on their tenants. STAGG studied the careers of 2,631 Harvard men of the classes of 1876-1912 whose body types had been recorded photographically during undergraduate physical training programs. He coded the in-


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formation that he gathered and punched it on cards. Then he ran the cards through sorting machines to see how the career of each man compared with his physique. When the information cards were processed by the machine, they showed that lean and non-muscular Harvard students tended to become government officials or parsons. Moderately lean students with better muscles than average often became successful scientists. Harvard-bred artists usually developed out of students with medium fleshiness and below-par muscles. The heavy but muscular students went in for practical callings of engineering or business and generally succeeded, while lighter-bodied competitors dropped out. A few of the Harvard men took to manual labor, but only the poorer-muscled ones stayed at that level. The better-muscled soon rose to positions where they didn't need muscles.

—*Time*, quoted in *Management Review*, January, 1962.

## No Evidence

THERE is no evidence that consumption of foods resulting from the use of new chemicals in crop production or in the processing of foods has created mysterious diseases and epidemics or endangered the health of the people. A statement by the Food Protection Committee notes that these chemicals are essential in the production and processing of many crops. Panels of outstanding scientists, nutritionists, government specialists, and industrial research men based their report on a year's study of scientific data on the benefits and possible hazard of chemicals used in connection with foods. "Contrary to some ideas that have been circulated, reliable food processors have not reduced the nutritional quality of our foods or created inferior products through the use of chemical additives," the statement reads. "Actually, the quality and sanitary characteristics of our foods have been improving." Recognizing the challenge to increase and improve food production, the Committee adds: "It is to the credit of industrial concerns and law-enforcing agencies that they have been able to make so much progress without jeopardizing the health of the public."

—National Research Council Release, December 11, 1951.

## Occupational Anemia

ELEVEN men who had frequently served as blood donors developed a severe anemia character-


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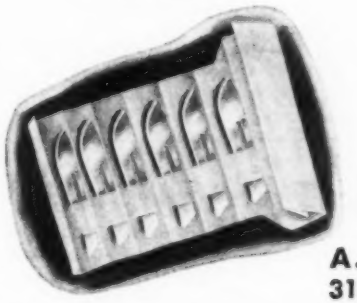

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ized by hypochromia, low plasma iron levels, absence of appreciable reticulocytosis and (in most cases) by microcytosis. Frequency of blood donations ranged from "occasional" to as many as 29 in two years.

—Clinical Brief: BATEMAN, J. C., in *Ann. Int. Med.*, 34:393, 1951.

## "The Worst Years of Our Lives"

THE "average American" at age 29 can look forward to paying taxes totaling a minimum of $34,743.23, or 22% of his earnings in the 36 years remaining of his working life. He will have the income from 28 of these years for himself, but the other eight years he will work to supply the demands of his governments. Taking into account the changes in the tax picture as his children grow up and become self-supporting, his standard tax charges for the years until he reaches 65 are figured as follows: Federal income, $15,684.00; Social Security, $3,573.00; real property, $7,200.00; personal property, $720.00. However, being average, the man will live to be 68, and thus collect Social Security for three years.

—*Credit Ezecutive*, quoted in *Management Review*, January, 1952.

## Aging Population

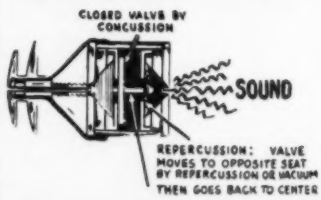
TODAY there are only five adult workers in the United States for every person 65 years old or over; in 1850 there were 11 workers, 16 years old or over, for every oldster. In another 10 years, under current population trends, there will be approximately four people at work for every person 65 or over. These figures point up the fast-mounting problems of our aging population. Simply voting the old people more dollars is no solution, either for them or the nation; old people do not consume dollars—they consume goods, like everyone else. Therefore any practical program of security for our aged must meet two basic requirements: (1) Production of goods and services by our young and middle-aged people must be expanded much further through industrial progress so that there will be a greater margin left over to take care of helpless older members of our population. (2) At the same time, our increasing numbers of older people must be permitted to work productively as long after 65 as possible. Most Americans want to stay useful after 65. A recent survey of the retirement aims of 3,000 male policyholders showed that only 24% want complete leisure when they reach retirement age. The remaining 76% want either to keep on at their present jobs as long as they are physically and mentally capable, or else to be financially able to ease up a bit, with shorter hours or in some lighter occupation.

—*Insurance Advocate*, quoted in *Management Review*, January, 1952.

## Education

THE COMPANY health program should embody the recognition that education is stronger than enforcement or propaganda.

—From "Setting Up A Safety Program," by J. PATERSON, *Canadian Metals*, February, 1952.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